UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

ENVIRONMENTAL ASSESSMENT

Canada Goose Damage Management
in
the State of North Carolina

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

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LIST OF ACRONYMS

AAWV	American Association of Wildlife Veterinarians
AC	Alpha chloralose
AP	Atlantic Population
APHIS	Animal Plant Health Inspection Service
BCC	Biological Carrying Capacity
CEQ	Council of Environmental Quality
CFR	Codes of Federal Regulation
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FDA	U.S. Food and Drug Association
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
INAD	Investigational New Animal Drug
IPM	Integrated Pest Management
IWDM	Integrated Wildlife Damage Management
NEPA	National Environmental Policy Act
NHPA	The National Historic Preservation Act
MBTA	Migratory Bird Treaty Act
MIS	Management Information System
MOU	Memorandum of Understanding
MWS	Mid-winter Waterfowl Survey
NAP	North Atlantic Population
NHPA	National Historical Preservation Act
NOA	Notice of Availability
NCDA	North Carolina Department of Agriculture
NCDNR	North Carolina Department of Natural Resources
NCWRC	North Carolina Wildlife Resources Commission
NWRC	National Wildlife Research Center
RP	Resident Population
SJBP	Southern James Bay Population
T&E	Threatened and Endangered Species
USFWS	U.S. Department of Interior, Fish and Wildlife Service
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USGS	U.S. Geological Survey
WAC	Wildlife Acceptance Capacity
WS	Wildlife Services

1.0 CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 Introduction

The United States Department of Agriculture (USDA) is authorized by law to protect American agriculture and other resources from damage associated with wildlife. The primary statutory authority for the Wildlife Service (WS) program is the Act of March 2, 1931, as amended (7 U.S. C. 426426c; 46 Stat. 1468); the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988 (P.L. 100202); and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 2001, Public Law 106-387, October 28, 2000. Stat. 1549 (Sec 767). WS activities are conducted in cooperation with other federal, state and local agencies, and private organizations and individuals. Federal agencies, including the United States Department of Interior, United States Fish and Wildlife Service (USFWS), recognize the expertise of WS to address wildlife damage issues related to migratory birds.

Wildlife damage management is defined as the alleviation of damage or other problems caused by or related to the presence of wildlife, and it is an integral component of wildlife management (Leopold 1933, The Wildlife Society 1990, Berryman 1991). The WS program uses an Integrated Wildlife Damage Management (IWDM) approach (similar to Integrated Pest Management or IPM) in which a combination of methods may be used or recommended to reduce wildlife damage. IWDM is described in Chapter 1, 1-7 of the Animal Damage Control Program Final Environmental Impact Statement (USDA 1997). These methods include the alteration of cultural practices as well as habitat and behavioral modification to prevent damage. The reduction of wildlife damage may also require that the offending animal(s) be removed or that populations of the offending species be reduced through lethal methods.

WS's mission is to "provide leadership in wildlife damage management in the protection of America's agricultural, industrial and natural resources, and to safeguard public health and safety." This is accomplished through:

- training of wildlife damage management professionals;
- development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
- collection, evaluation, and dissemination of management information;
- cooperative wildlife damage management programs;
- informing and educating the public on how to reduce wildlife damage and;
- providing data and a source for limited use management materials and equipment, including pesticides (USDA 1989).

This environmental assessment (EA) evaluates ways by which this responsibility can be conducted to resolve damage and conflicts associated with Canada geese (Branta canadensis) in the state of North Carolina. WS strives to reach and maintain a balance between wildlife needs and welfare and human needs and welfare. Humans and Canada geese are both part of the environment and both sets of needs and welfare must be considered when selecting methods and approaches to be used in a Canada goose damage management program. WS conducts wildlife damage

management as a means of reducing damage, not in order to punish offending animals, to treat them inhumanely or abuse their welfare.
WS is a cooperatively funded and service oriented program. Before any operational wildlife damage management is conducted, Agreements for Control or WS Work Plans are completed by WS and the land owner/administrator. WS cooperates with private property owners and managers and with agencies, as requested and appropriate, with the goal of effectively and efficiently resolving wildlife damage problems in compliance with federal, state, and local laws, regulations, policies, orders, and procedures including the Endangered Species Act (ESA) and Migratory Bird Treaty Act (MBTA).

Most individual actions of the types encompassed by this analysis may be categorically excluded under the APHIS Implementing Regulations for compliance with the National Environmental Policy Act (NEPA) (7 CFR§372.5(c)). APHIS Implementing Regulations also provide that all technical assistance furnished by WS is categorically excluded (7 CFR§372.5(c)) (60 Federal Register 6,000, 6,003 (1995)). However, WS is preparing this EA to assist in planning Canada goose damage management activities and to clearly communicate with the public the analysis of cumulative impacts of issues of concern in relation to alternative means of meeting needs for such management in North Carolina. This analysis covers current and future Canada goose damage management activities by WS wherever and whenever they might be requested, on all public and private lands in North Carolina.

This EA documents the analysis of the potential environmental effects of the proposed program. This analysis relies mainly on existing data contained in published documents (Appendix A), and on the Animal Damage Control Final Environmental Impact Statement (USDA 1997).

1.2 Purpose

The purpose of this EA is to analyze the effects of WS activities in North Carolina to reduce damage and conflicts associated with Canada geese. Resources potentially protected by such activities include property, agriculture, natural resources, quality of life, human health, and human safety.

1.2.1 Summary of Proposed Action

The proposed action is for WS to continue to implement an Integrated Canada Goose Damage Management Program that responds to requests for the protection of property, agricultural resources, natural resources, quality of life, human health, and human safety in North Carolina. Requests for assistance may occur anywhere and anytime throughout the state. The program would include the use of legal techniques and methods, used singly or in combination, to meet requestor needs for reducing conflicts with Canada geese (Appendix B). Cooperators requesting assistance would be provided with information regarding the use of effective nonlethal and lethal techniques. Nonlethal methods recommended and used by WS may include resource management, physical exclusion, relocation, and deterrents (Appendix B). Lethal methods recommended and used by WS may include nest/egg destruction, live capture and transportation to a licensed poultry processing facility, live capture and euthanasia, and/or shooting (Appendix B). In many situations,

the implementation of nonlethal methods such as manipulation of habitat, application of repellents, and installation of fencing, flagging, and exclusion devices would be conducted by the requestor. Wildlife damage management assistance regarding Canada geese would be conducted by WS in North Carolina, when requested, on private and public property and facilities where a need exists and pursuant to an Agreement for Control.
The proposed program would be conducted pursuant to applicable laws and regulations authorizing take of Canada geese and their nest and eggs, developed through partnerships among WS, the U.S. Fish and Wildlife Service (USFWS), and the North Carolina Wildlife Resources Commission (NCWRC), and as requested by and through coordination with requestors of assistance. All management actions would comply with applicable federal, state, and local laws.

1.3 Need for Action

Wildlife management is often perceived as the struggle to preserve threatened and endangered (T & E) species, regulate species exploited by humans and the humans who exploit them, and conserve the landscape that provides habitat for wildlife resources. Increasingly, however, cities, towns, parks, and private properties have become sites of some of the greatest challenges for wildlife management. When the presence of prolific adaptable species such as Canada geese is combined with human interest in seeing and being close to wildlife, conflicts often develop. Long thought of as a spectacular sight during the spring and fall migration, Canada geese are now frequently and abundantly present in cities and towns throughout North Carolina and across the United States. They are generally regarded as providing ecological, educational, economic, recreational, and aesthetic benefits (Decker and Goff 1987), and there is enjoyment in knowing wildlife exists and contributes to natural ecosystems (Bishop 1987). Canada geese, like all wildlife, provide people with valued contact with nature. They contribute to the quality of life in North Carolina. Many people, even those experiencing damage, consider Canada geese to be a charismatic and valuable component of their environment. However, tolerance of goose behavior differs among people (Smith et al. 1999). Because of their prolific nature, site tenacity, longevity, size, and tolerance of human activity, Canada geese are often associated with problem situations. Increasing populations of resident geese are resulting in increasing numbers of conflicts with human activities (Conover and Chasko 1985), and increasing concerns related to human health and safety (Ankney 1996). Because they can fly, Canada geese are mobile, they exploit a variety of habitats and sites within a given area, and they cannot be permanently excluded from an area. Additionally, management of goose-related problems often exceeds the capabilities of single landowners to reduce damage to tolerable levels. In North Carolina, problem situations associated with Canada geese typically involve, but are not limited to, unacceptable and potentially dangerous accumulations of feces, goose aggression during the nesting season, grazing of landscaped vegetation, damage to agricultural and natural resources, and unacceptable safety hazards for vehicles (automobiles, boats, airplanes). These problems frequently occur on private home properties, apartment/condominium complexes, municipal parks, schools, hospitals, natural/habitat restoration sites, corporate and industrial sites, office complexes, roadways, airports, and other areas.

1.3.1 Wildlife Acceptance Capacity and Biological Carrying Capacity

Human dimensions of wildlife management include identifying how people are affected by problems or conflicts with wildlife, attempting to understand people's reactions, and incorporating this information into policy and management decision making processes and programs (Decker and Chase 1997).

Wildlife Acceptance Capacity (WAC), sometimes known as cultural carrying capacity, is the maximum wildlife population level in an area that is acceptable to people (Decker and Purdy 1988). This phrase is important because it defines the sensitivities of the local community to a specific wildlife species or problem. For wildlife damage situations, there will be varying thresholds for those people directly and indirectly affected by the damage. This threshold of damage is a primary limiting factor in determining the WAC.

Biological Carrying Capacity (BCC) is the wildlife population level that the land or habitat can support without degradation to the populations health, animals' health or the environment over an extended period of time (Decker and Purdy 1988). While the biological carrying capacity for resident Canada geese in North Carolina may be greater than the statewide population, the WAC is probably lower. Once this WAC is met or exceeded, people seek to implement goose population reduction methods to alleviate property damage and threats to quality of life, human health or safety.

1.3.2 Canada Geese In North Carolina

Canada geese are one of North America's greatest wildlife success stories, and most biologists believe that there are more Canada geese now than at any time in history (Rusch et al. 1995, Ankney 1996). The total number of Canada geese counted during the winter in North America has increased from 980,000 in 1960 to 3,734,500 in 2000 (Mid-winter Survey unpublished reports). There are two behaviorally distinct types of Canada goose populations: Resident and Migratory. Based upon a 1998 survey, the North Carolina Wildlife Resources Commission (NCWRC) estimates the NC spring breeding population of resident Canada geese at 96,505 individuals (North Carolina Wildlife Resources Commission 2001). During the winter, numbers of Canada geese likely exceed 105,814[1] in North Carolina. These birds are a mix of resident Canada geese that nest in NC, resident Canada geese that nest in neighboring states, and migratory geese (J.Fuller, NCWRC, Pers. comm., 2001).

Flyway Councils, which are comprised of representatives from member States and Provinces, make recommendations to the USFWS on matters regarding migratory game birds. The flyway system is divided into four administrative units; the Atlantic, Mississippi, Central, and Pacific Flyway Councils. North Carolina is considered part of the Atlantic Flyway Council for the management of migratory birds.

[1] The migratory Canada goose estimate for 2001 was 9,309, while the resident population, based on a 1998 survey, was 96,505, totaling 105,814 Canada geese.

1.3.2.1 Ecology, Behavior and Population Status

1.3.2.1.1 Resident Canada Geese

A resident Canada goose is one that nests and/or resides on a year round basis within the conterminous United States (Rusch et al. 1995, Ankney 1996). More specifically, the Atlantic Flyway Council defines a "resident" Canada goose in the Atlantic Flyway as geese that are hatched or nest in any Atlantic Flyway state, or in Canada at or below 48^0 N latitude and east of 80^0 W longitude, excluding Newfoundland. This population inhabits the States along the U.S. Atlantic Coast, southern Quebec, and the southern Maritime Provinces of Canada (USFWS 2001). As their name implies, resident Canada geese spend most of the year near their breeding areas, although many in northern latitudes do make seasonal movements (Atlantic Flyway Council 1999). The Atlantic Flyway's resident Canada goose population is comprised of various subspecies or races of Canada geese, including *B.c.maxima, B.c.moffetti, B.c. interior, B.c.canadensis*, and possibly other subspecies, reflecting their diverse origins (Dill and Lee 1970, Pottie and Heusmann 1979, Benson et al. 1982, in AFC 1999). Giant (*B.c.maxima*) and western Canada geese (*B.c.moffetti*) are the largest 2 of the 11 subspecies, ranging in weight from 8 to 15 pounds. Resident Canada geese were introduced into the Atlantic Flyway during the early 1900's and now comprise the largest population of geese in the Flyway, with an estimated 1.1 million birds in Spring1999 (Atlantic Flyway Council 1999). In 2002, the spring resident goose population for the Atlantic Flyway was estimated at 966,000 ($\pm$ 170,400) geese in the northeastern United States (USFWS 2002). Annual estimates of the Atlantic Flyway resident Canada goose population have increased an average of 5% per year since 1993 (USFWS 2002). As reported by the North American Breeding Bird Survey, resident breeding populations of Canada geese in the Eastern Breeding Bird Survey Region and North Carolina have increased annually at rates of 16% and 28.8%, respectively, from 1980-2000 (Sauer et al. 2001).

Resident Canada geese become sexually mature and breed at two or three years of age and have a relatively high nesting success compared to migrant Canada geese (USFWS 2001). A statewide study of resident goose population ecology in New Jersey indicated that resident goose nest success is high and generation time is shorter for resident geese than for migrant geese (Atlantic Flyway Council 1999). On average, 67% of all goose nests hatched at least one gosling, and gosling survival was good. Survival rates based on leg band recoveries averaged 83% for all age classes (Castelli and Trost 1996). Population modeling indicated that the New Jersey resident population could be expected to double in 11 years. Breeding resident Canada geese occur in every county of North Carolina, and nest primarily during March-June each year. In North Carolina, resident Canada geese nest in traditional sites (along shorelines, on islands and peninsulas), as well as on rooftops, adjacent to roadways, swimming pools, and in parking lots, playgrounds, planters, and abandoned property (tires, automobiles, etc.).

Molting is the process whereby geese annually replace their primary and secondary flight (wing) feathers (Welty 1982). In North Carolina, resident Canada geese molt, and are

flightless, from mid-June through mid-July each year. Portions of a flock of geese can be flightless from about one week before and two weeks after molt due to the asynchronous molting by individual birds. Non-breeding resident Canada geese and geese which have failed nesting attempts sometimes move to other areas in the summer prior to molting (Zicus 1981, Nelson and Oetting 1991, Abraham et al. 1999).

Resident Canada geese are thought to be increasing throughout the state. The number of resident Canada geese in North Carolina in 1986 was estimated at 5,313 birds. In 1999 the resident population had increased to an estimated 96,505 geese based upon an assumed annual rate growth in the population of about 25% (Atlantic Flyway Council 1999).

The resident Canada goose management goal of the Atlantic Flyway Council is to achieve an optimal balance between the positive values and conflicts associated with these birds (Atlantic Flyway Council 1999). Five Management Objectives are identified in the Atlantic Flyway Resident Canada Goose Management Plan (Atlantic Flyway Council 1999):

1. Reduce resident Canada goose populations in the AF to 650,000 birds (spring estimate) by 2005, distributed in accordance with levels prescribed by individual states and provinces. The North Carolina population goal is 30,000 resident Canada geese.
2. Permit a wide variety of effective and efficient options for relief of damage and conflicts associated with resident Canada geese.
3. Provide maximum opportunities for use and appreciation of resident Canada geese, consistent with population goals.
4. Ensure compatibility of resident goose management with management of migrant goose populations in the AF, and vice versa.
5. Annually monitor populations, harvest, and damage/conflict levels to evaluate effectiveness of management options.

1.3.2.1.2 Migratory Canada Geese

Migratory Canada geese are those which nest and raise their young in the arctic and sub-arctic regions of Canada. Migrant geese begin moving north in time to arrive on their breeding grounds concurrent with the disappearance of ice cover and the availability of nest sites. Migrant geese arrive on the breeding grounds from mid-April on James Bay, late April for Hudson Bay, mid-May for the Yukon-Kuskokwin Delta of Alaska, to June for the islands in the Arctic (Bellrose 1980). Most subspecies of migratory geese do not nest until the ages of 3-5 years (Hardy and Tacha 1989, Moser and Rusch 1989, Rusch et al.1996). Migrating Canada geese move northward fairly gradually following the retreating snow cover (Bellrose 1980). For the last portion of migration, northern-nesting geese often overfly areas of snow in boreal forests to arrive on Arctic and Subarctic nesting areas just as spring breaks. The most southerly wintering geese leave their wintering areas in January and geese wintering at middle-latitudes move northward in March or April (Bellrose 1980).

Migrant Canada geese move much farther to wintering areas than do resident geese and are typically found in North Carolina interspersed among resident goose populations during the fall and winter months. In the Atlantic flyway, migratory Canada geese consist primarily of the Atlantic Population (AP), North Atlantic Population (NAP), and the Southern James Bay Population (SJBP) (USFWS 2002). The wintering migratory population in North Carolina is mostly comprised of the AP and SJBP population with Christmas Bird Count data from 1959-1988 shows a decreasing trend in North Carolina (Sauer 1996).

The USFWS provides the following status report for the three migratory populations of Canada geese in the Atlantic flyway (USFWS 2002):

Atlantic Population
This population of migratory Canada geese nest throughout Quebec, especially along the Ungava Bay, the eastern shore of Hudson Bay, and the Ungava Peninsula and winters from New England to South Carolina (U.S. Fish and Wildlife Service 2002). In 2002, the number of breeding pairs for the Atlantic Population was estimated to be 164,800, 12% above the 2001 estimate. This population continues to increase from a low of 29,000 breeding pairs in 1995. The breeding pairs estimates have increased 13% per year since 1993. The estimated total 2002 spring population of Atlantic Population geese was 973,600 birds. This was a 53% increase above the 2001 estimate (U.S. Fish and Wildlife Service 2002).

North Atlantic Population
This population of migratory Canada geese nests in Newfoundland and Labrador, and although they do mix with AP and Resident geese during the winter, they maintain more coastal distributions (U.S. Fish and Wildlife Service 2002). In 2002, there were an estimated 62,000 pairs of geese in the NAP, essentially unchanged from 2001. Indicated pair estimates have declined an average of 6% per year since 1996. There are an estimated 129,600 NAP geese in the Atlantic Flyway in 2002, a 49% increase over 2001 estimates.

Southern James Bay Population
This population nests on Akimiski Island in James Bay and in the adjacent Hudson Bay lowlands to the south and west. The Southern James Bay Population winters from southern Ontario and Michigan to Mississippi, Alabama, Georgia, and South Carolina. In 2002, breeding ground surveys indicated a spring population of 76,300 geese. The 10 year breeding population trend appears to be relatively stable.

1.3.2.2 Historical Information

Four populations of Canada geese (3 migratory and 1 resident) can be found in North Carolina. The 3 migratory populations (Atlantic, North Atlantic, and Southern James Bay) have experienced tremendous declines in wintering numbers in North Carolina for the last 40 years. Conversely, the Resident Population (RP) in North Carolina as well as other Atlantic Flyway states has undergone tremendous growth since the mid 1980's (NCWRC, Status Report, 2001).

1.3.2.2.1 Resident Canada Geese

The Atlantic Flyway Council's Resident Canada Goose Management Plan (Atlantic Flyway Council 1999) contains a detailed history of resident geese in the flyway, and it is summarized and paraphrased here. Resident Canada geese are distinctly different from Canada geese that nested in the Flyway historically. The original stock in pre-colonial times was primarily *B.c. canadensis* (Delacour 1954), but they were extirpated long ago. The present day population was introduced and established during the 1900's after they were released by private individuals. When the use of live decoys for hunting was prohibited in 1935, captive flocks of domesticated or semi-domesticated geese were numerous (more than 15,000 birds), and many were liberated in parks or allowed to wander at large (Dill and Lee 1970). From the 1950s through the 1980s, many AF state wildlife agencies relocated and stocked resident geese, primarily in rural areas. These programs were successful, and all were discontinued by 1990. In the 1980's, biologists began to recognize that increasing numbers of resident Canada geese were masking a decline in the number of migratory AP geese wintering in the Flyway. Banding studies have confirmed that resident geese are not AP geese that simply stopped migrating north to breed; they are distinct populations with very different management needs and opportunities (Atlantic Flyway Council 1999).

The following passages describe resident Canada goose historical information for North Carolina (Atlantic Flyway Council 1999):

"In that portion of the state approximately west of I-95, the resident goose population was most likely due to the movement of birds from adjacent states, particularly South Carolina, Georgia, and Virginia. Only one flock in the Piedmont is known to be the result of stocking by the Wildlife Commission. Private individuals, who maintained flocks for use as live-decoys or practiced aviculture, released some additional birds."
"In the lower coastal plain, east of I-95, resident goose populations largely descended from birds stocked by the Wildlife Commission during the 1980s. Several thousand nuisance geese were transported to North Carolina from Ontario, Pennsylvania, New York, New Jersey, Connecticut, and Delaware, and released"

1.3.2.2.2 Migratory Canada Geese

The original, pre-settlement, stock of Canada geese that occurred in the Atlantic Flyway were *B.c. canadensis* (Delacour 1954 in Atlantic Flyway Council 1999). Canada geese are endemic to North America, where they occur in each state of the United States (except Hawaii), each Province of Canada, and many States of Mexico. Most authorities currently recognize 11 subspecies of Canada geese, which differ primarily in body size and color (Bellrose 1980). Canada goose migrations may encompass up to 3,000 miles, like that of the Richardson's Canada goose (*B.c. hutchinsii*) which nests as far north as Baffin Island, Nunavut, Canada and winters as far south as the eastern States of Mexico. Migrant geese nest across the arctic, subartic, and boreal regions of Canada and Alaska and range in size

from the 2-4 pound cackling Canada goose (*B.c. minima*) to the 7-10 pound dusky Canada goose (*B.c. occidentalis*).

1.3.3.2 Canada Goose Hunting in North Carolina

Hunting occurs statewide during most of September. A special September goose hunting season occurs from September 2-20 (NE counties) and September 3-30 (except NE counties). Bag limits have increased periodically during the September season in hopes of slowing population growth and currently 5 geese per day in September are allowed statewide with the exception of Currituck and Dare counties where there is a 2 goose per day bag limit. Although the NCWRC does not think an increased bag limit in these 2 counties would substantially reduce resident goose numbers, the limit was reduced in response to local requests. Hunting in September is targeted towards resident geese as very few or no migrant geese have arrived at this time. Hunting for resident geese may have lowered the rate of population increase in some areas, but has not appeared to decrease numbers of resident geese in any area. Hunting for resident geese also occurs in that area of the state outside of the Northeast Hunt Unit during the regular season. The 2001-02 regular goose seasons are set for November 3rd – December 31st. While NCWRC currently follow hunting season framework guidelines for Southern James Bay Population (SJBP) geese in this area, the season is set prior to the arrival of many SJBP geese. This should maximize hunting opportunities for Resident Population (RP) geese while limiting pressure on SJBP geese (NCWRC, Status Report, 2001).

Table 1-1 provides available hunter harvest data for these 2 hunting seasons since 1997.

While the Special Winter and Special September seasons have contributed in targeting harvest of resident geese, additional strategies are needed to effectively manage the resident goose population (Mississippi Flyway Council Technical Section 1996). Resident geese also avoid hunting mortality through their extensive use of urban and suburban environments. Resident Canada goose harvest rates are not uniform throughout a large area such as a state. Urban-suburban areas often provide exceptional goose habitat and allow geese to remain in "refuges" and avoid peak harvest periods (i.e., weekends).

Table 1-1. Number of Canada geese harvested in North Carolina during Regular and Special September Seasons during 1997-2002 (NCWRC, Status Report, 2001).

Year	Number of Geese Harvested Regular Season	Number of Geese Harvested Special September Season	Total
1997-1998	*	*	17,100
1998-1999	15,400	8,500	23,900
1999-2000	13,700	6,200	19,900

2000-2001	20,400	9,000	29,400
2001-2002	19,700	10,500	30,200

*Breakdown not available for 1997-1998 Regular and September Seasons.

1.3.4 Canada Goose Damage and Conflicts

Canada geese are perhaps the most widely recognized birds in North America. They are opportunistic and extremely adaptable, utilizing the food and protection provided by humans in urban landscapes for nesting, raising young, molting, feeding, and resting. Since Canada geese require fresh water for drinking, resting, nesting, and new tender grasses, grains, or other succulent vegetation for feed, the well-manicured lawns of homes, golf courses, and parks located near water provide ideal habitat. This has led to increasing numbers of conflicts between Canada geese and people.

The management of resident Canada goose damage to protect human health, human safety, property, agriculture and natural resources invariably leads to a better quality of life for affected parties. WS is not legislatively mandated to protect quality of life, but it is accomplished, indirectly, as a secondary result of goose damage management practices. Requests for WS assistance are categorized according to resource category (agriculture, property, natural resources, and human health and safety) and year. For the 5-year period Fiscal Year 1998 through Fiscal Year 2002, a total of 1002 goose-related requests were received. Damage to property (711 requests, 71 % of requests), and damage to agriculture (142 calls, 14 %) are the most frequent types of damage. Requests for assistance regarding damage to human health and safety (124 requests) and natural resources (25 requests) are less frequent (Table 3). The Atlantic Flyway council recognizes the damage and potential threats that overabundant resident Canada goose populations may have on the environment including rural, urban, and suburban areas (Atlantic Flyway Council 1999).

Research on human landscape preference has revealed that humans have a strong predilection; some assert an innate preference, for savannas with water (Cooper, in press[a]). Cooper (in press [a]) also reported that like humans, but evolutionarily much earlier, Canada geese evolved to use the savanna landscape because the setting offered ample foraging opportunities, a high predator detection likelihood, and ready escape into nearby water. This preference for similar habitats has contributed to the increasing level of conflicts between humans and resident Canada geese.

Most nuisance complaints are associated with suburban areas where geese congregate on public or private ponds and forage on lawns and mowed areas associated with parks, beaches, golf courses, schools, business campuses, and residences. The major problems are associated with the impacts of goose feces and grazing damage to lawns and other areas (including sidewalks, driveways, swimming pools, etc.). Agricultural losses occur primarily in the late winter and spring. The major crops damaged are corn, soybeans, peanuts, winter wheat and improved pastures.

1.3.4.1 Canada Goose Threats to Human Health

Resident Canada goose conflicts may potentially impact human health. A foraging Canada goose defecates between 5.2 and 8.8 times per hour (Bedard and Gauthier 1986). Kear (1963 In Allan et al. 1995) recorded a maximum fecal deposition rate for Canada geese of 0.39 pounds per day (dry weight). Public swimming beaches, private ponds, and lakes have been affected by goose droppings. There are several pathogens involving waterfowl which may be contracted by humans, however, the risk of infection is believed low.

Cryptosporidiosis is a disease caused by the parasite Cryptosporidium parvum and was not known to cause disease in humans until as late as 1976 (Centers for Disease Control and Prevention (CDCP) 1998). A person can be infected by drinking contaminated water or direct contact with the droppings of infected animals (CDCP 1998). The public is advised to be careful when swimming in lakes, ponds, streams, and pools, and to avoid swallowing water while swimming (Colley 1996). The public is also advised to avoid touching stools of animals and to drink only safe water (Colley 1996). Cryptosporidium can cause gastrointestinal disorders (Virginia Department of Health 1995) and produce lifethreatening infections in immunocompromised and immunosuppressed people (Roffe 1987, Graczyk et al. 1998). Cryptosporidiosis is recognized as a disease with implications for human health (Smith et al. 1997). Canada geese in Maryland were shown with molecular techniques to disseminate infectious Cryptosporidium parvum oocysts through mechanical means in the environment (Graczyk et al. 1998). Giardiasis (Giardia lambia) is an illness caused by a microscopic parasite that has become recognized as one of the most common causes of waterborne disease in humans in the United States during the last 15 years (CDCP 1999). Giardiasis is contracted by swallowing contaminated water or putting anything in your mouth that has touched the stool of an infected animal or person, and causes diarrhea, cramps and nausea (CDCP 1999). Canada geese in Maryland were shown with molecular techniques to disseminate infectious Giardia sp. cysts in the environment (Graczyk et al. 1998).

Salmonella (Salmonella spp.) may be contracted by humans by handling materials soiled with bird feces (Stroud and Friend 1987). Salmonella causes gastrointestinal illness, including diarrhea.

Table 1-2. Number of requests for damage management assistance regarding Canada geese received by USDA APHIS Wildlife Services during Federal Fiscal years 1998 through 2002 (USDA unpublished reports).

Year	Agriculture	Property	Natural Resources	Human Health & Safety	Total
1998	22	175	1	8	206
1999	14	51	0	6	71
2000	34	134	0	23	191

2001	28	191	17	52	288
2002	44	160	7	35	246
Total	142	711	25	124	1002

Chlamydia psittaci, which can be present in diarrhetic feces of infected waterfowl, can be transmitted if it becomes airborne (Locke 1987). Severe cases of Chlamydiosis have occurred among wildlife biologists and others handling snow geese, ducks, and other birds (Wobeser and Brand 1982). Chlamydiosis can be fatal to humans if not treated with antibiotics. Waterfowl, herons, and rock doves (pigeons) are the most commonly infected wild birds in North America (Locke 1987).

Escherichia coli (E. coli) are fecal coliform bacteria associated with fecal material of warm blooded animals. There are over 200 specific serological types of E. coli and the majority are harmless (Sterritt and Lester 1988). Probably the best known serological type of E. coli is E. coli O157:H7, which is a harmful E. coli usually associated with cattle (Gallien and Hartung 1994). This was the rationale for testing public water supplies that was developed in the United States and Europe at the turn of the century to reduce the incidence of waterborne diseases.

Regardless of whether the serological types of E. coli disseminated into watersheds by geese are proven to be harmful to humans, it has been demonstrated that Canada geese can disseminate E. coli into the environment and result in elevated fecal coliform densities in the water column (Hussong et al. 1979). Many communities monitor water quality at swimming beaches, but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards the beaches are temporarily closed adversely affecting the human quality of life, even though they may not have been able to determine the serological type of the E. coli. Unfortunately, linking the elevated bacterial counts to frequency of waterfowl use and attributing the elevated levels to human health threats has been problematic until recently. Advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific animal species and link these animal sources of coliform bacteria to fecal contamination (Jamieson 1998, Simmons et al. 1995). Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998). Also, fecal coliform bacteria counts coincided with the number of Canada geese and gulls roosting at the reservoir.

Roscoe (1999) conducted a survey to estimate the prevalence of pathogenic bacteria and protozoa in resident Canada geese in NJ, and found no Salmonella sp., Shigella sp., or Yersinia sp. Isolated from any of the 500 Canada goose samples. However, he did report finding Cryptosporidium sp. in 49 (10%) of the 500 geese, and Giardia sp. in 75 (15%) of the geese. Additionally, the USGS (U.S. Geological Survey 2000) conducted field studies

in NJ, VA, and MA to determine the presence of organisms that could cause disease in human exposed to feces of Canada geese at sites with a history of high public use and daily use by geese. Salmonella spp., Listeria spp., Chlamydia sp., and Giardia spp. were isolated from goose feces in New Jersey (U.S. Geological Survey 2000).

While transmission of disease or parasites from geese to humans has not been well documented, the potential exists (Luechtefeld et al. 1980,Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blandespoor and Reimink 1991, Graczyk et al. 1997, Saltoun, et al. 2000). In worst case scenarios, infections may even be lifethreatening for immunocompromised and immunosuppressed people (Roffe 1987, Virginia Department of Health 1995, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting disease from feces is believed to be small. Financial costs related to human health threats involving resident Canada geese may include testing of water for coliform bacteria, cleaning and sanitizing beaches regularly of feces, contacting and obtaining assistance from public health officials, and implementing nonlethal and lethal methods of wildlife damage management. WS recognizes and defers to the authority and expertise of local and state health officials in determining what does or does not constitute a threat to public health.

1.3.4.2 Need to Protect Human Safety From Canada Geese

Bird strikes cause an estimated seven fatalities to civilian and military aircraft each year (Linnell et al. 1996). For the period 1990-2000, waterfowl (geese and ducks) comprise 11% of all bird-aircraft strikes to civil aviation reported to the FAA for which bird species or group was reported (Cleary et al. 2002). For the period 1990-2000, more than 50% of Canada goose-aircraft strikes resulted in damage to the aircraft, and 28.5% resulted in a negative effect on the flight (Cleary et al. 2002). For example, in 1995, a Boeing 707 E38 AWACS jet taking off from Elmendorf Air Force Base in Alaska ingested at least 13 geese into the number 1 and 2 engines and crashed, killing all 24 crew members. The Canada goose is the most massive bird (8-15 pounds) that is commonly struck by aircraft, and nationally, this species was responsible for a disproportionately large amount of damage to civil aircraft involved in strikes with wildlife during 1990-2000 (Cleary et al. 2000). Nationally, the resident Canada goose population probably represents the single most serious bird threat to aircraft safety at this time (Alge 1999 in Cleary et al. 2000). For the period 1990-2000, 12 Canada goose-aircraft strikes were reported, as well as 8 unidentified goose-aircraft strikes, by civilian airports in NC to the FAA (FAA National Wildlife Strike Hazard Database 2003). It is estimated that only 20-25% of all bird strikes are reported (Conover et al. 1995, Dolbeer et al. 1995, Linnell et al. 1996, Linnell et al. 1999).

According to Dolbeer et al. (2000), geese rank as the third most hazardous type of wildlife in regards to aviation safety. Bird strikes involving Canada geese are a realized scenario at airfields in North Carolina. Elements of 2nd Marine Air Wing aviation experienced the worst case scenario approximately 6 years ago Field Carrier Landing Practice operations (e.g., touch and go) at MCALF Bogue. An EA6-B Prowler struck and ingested a number of geese during operations. Luckily the pilot was able to proceed to an uninhabited area

over nearby Croatan National Forest where the crew ejected safely however the plane crashed. The aircraft was a total loss (M.Begier, USDA-WS, Pers. comm., 2001).

Geese aggressively defend their nests, nesting areas, and goslings, and may attack or threaten pets, children, and adults (Smith et al. 1999). Goose attacks on people are fairly common occurrences in North Carolina during the nesting season and can result in injuries. Additionally, slipping hazards can be created by the buildup of feces from geese on docks, walkways, and other foot traffic areas, especially near nesting areas where geese spend a considerable amount of time during a concentrated time period (April-May). Geese nesting near roadways create traffic hazards when they cross the roadway or defend a nest site from cars and pedestrians, potentially resulting in accidents and human injuries.

1.3.4.3 Need to Protect Property From Canada Geese

Geese may cause damage to aircraft, automobiles, landscaping, piers, yards, boats, beaches, shorelines, parks, golf courses, landscaping, driveways, athletic fields, ponds, lakes, rafts, porches, patios, gardens, foot paths, swimming pools, play grounds, school grounds, and cemeteries. Damage reported through technical assistance generally is not verified by field investigation by WS. The majority of people that contact WS for assistance describe a general decline in their quality of life due to local overabundance of geese. In many cases, people are unable to use and enjoy their own property, public parks, and other areas because of goose feces.

Costs associated with property damage include labor and disinfectants to clean and sanitize the area, loss of property use and resale value, loss of aesthetic value of plants, gardens, aquatic vegetation, and lawns where geese feed and loaf, loss of customers or visitors irritated by having to walk on feces, and loss of time contacting wildlife management agencies on health and safety issues and damage management advice, and implementation of nonlethal and lethal wildlife management methods.
The costs of reestablishing overgrazed lawns and cleaning goose feces from sidewalks have been estimated at more than $60 per bird (Allan et at. 1995).

1.3.3.4 Need to Protect Agriculture from Canada Geese

Canada geese graze a variety of crops, including alfalfa, barley, beans, corn, soybeans, wheat, rye, oats, spinach, and peanuts (Atlantic Flyway Council 1999). A single intense grazing event by Canada geese in fall, winter or spring can reduce the yield of winter wheat by 16-30% (Fledger et al. 1987), and reduce growth of rye plants by >40% (Conover 1988). However, some have reported that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985). The most common Canada goose damage to agricultural resources in North Carolina is depredation on winter wheat, sweet and field corn, soybeans, vegetables, pasture, and alfalfa. Damage is primarily consumption (and loss of the crop and revenue), but also consists of unacceptable accumulations of feces on horse pastures, trampling of wheat, and increased erosion and runoff from fields where the cover crop has been grazed. During Federal Fiscal Years

1998 -2002, a total of 142 requests for assistance were received by WS regarding goose damage to agriculture in NC (USDA unpublished reports 2002).

1.3.3.5 Need to Protect Natural Resources From Canada Geese

Soil erosion and sedimentation can cause damage to natural resources. Excessive numbers of Canada geese can remove bank vegetation resulting in erosion of the shoreline and soil sediments being carried by rainwater into lakes, ponds and reservoirs. Geese may cause damage to natural vegetation, shorelines, parks, ponds, and lakes.

Nutrient loading has been found to increase in wetlands in proportion to increases in the numbers of roosting geese (Kitchell et al. 1999, Manny et al. 1994). In studying the relationship between bird density and phosphorus (P) and nitrogen (N) levels in Bosque del Apache National Wildlife Refuge in New Mexico, Kitchell et al. (1999) found an increase in the concentration of both P and N correlated with an increase in bird density. Scherer et al. (undated) stated that waterfowl metabolize food very rapidly and most of the phosphorus contributed by bird feces probably originates from sources within a lake being studied. In addition, assimilation and defecation converted the phosphorus into a more soluble form and, therefore was considered a form of internal loading. Waterfowl have contributed substantial amounts of P and N into lakes through feces creating excessive aquatic macrophyte growth and algae blooms (Scherer et al. undated) and accelerated eutrophication through nutrient loading (Harris et al. 1981).

Waterfowl, including Canada geese, are considered by the American Association of Wildlife Veterinarians (AAWV) as susceptible to and carriers of disease and parasites. Because of the potential threat to free-ranging waterfowl, the AAWV put forth the following resolution (AAWV, undated):

> "*...wild and semi-domestic ducks, geese and swans are susceptible to and carriers of disease and parasites of free-ranging wild ducks, geese, and other birds;...*"
>
> "*...the AAWV encourages local authorities and state and federal agencies to cooperate to limit the population of waterfowl on urban water areas to prevent disease outbreaks in semidomestic as well as freeranging ducks, geese and swans and discourages the practice of relocating nuisance or excess urban ducks, geese and swans to other parks or wildlife areas as a means of local population control.*"

1.3.4 ACTIVITIES BY WS TO ALLEVIATE CANADA GOOSE DAMAGE IN NORTH CAROLINA

Wildlife Services in NC has been involved in a number of activities to help reduce the negative impacts of overabundant geese. North Carolina WS began its first operational goose damage management project in 1990. A total of 71 operational goose damage management projects have been conducted as of 2002. The following is a description of a portion of the goose projects conducted by North Carolina WS.

- In 2001, WS entered into an agreement with a large airport to depopulate Canada geese that pose the threat of air strikes. When safe and appropriate, WS implemented an IWDM approach including the lethal removal of geese to reduce the potential health risks and damage; removal of all eggs and nests, to prevent future populations of geese from assuming residence at the airport; and the use of translocation, or removal of geese by live-capture, was also implemented for those geese unable to be removed earlier in the year. Removal of geese offered several advantages. This technique, when applied directly to the population, carried much less risk that the geese would move and create conflicts elsewhere. All management techniques helped to reinforce an ongoing non-lethal goose harassment program currently conducted throughout the year by airport personnel.

- A Water Treatment Plant entered into an agreement with WS in 2001 to reduce property damage and address human, health, and safety issues. Damaged turf, increasing soil erosion, and droppings in the grass and walkways were some of the most obvious. Human, health, and safety issues were also addressed regarding the geese physically attacking the water plant personnel as well as visitors. The potential disease threats from geese entering and contaminating the water supply also posed a serious concern. In order to reduce the potential health risks and damage, WS implemented an IWDM program including the addling of goose eggs, removal of goose nests, and other effective non-lethal harassment methods.

- In December 2000, WS entered into an agreement with a manufacturing company to reduce property damage and protect human, health and safety from resident Canada geese. In order to deter the geese from using the bodies of water located on the company's property where employees walk and picnic for lunch, WS implemented the IWDM approach in managing Canada geese including addling/oiling Canada goose eggs during the spring. WS also installed an overhead Kevlar line grid system denying the geese easy assess to the water. To increase effectiveness, a two strand perimeter fence was constructed to prevent geese from walking into the area under the grid. In addition, during the summer molt the geese were live captured and euthanized and disposed on in a humane and sanitary manner.

1.4 WS RECORD KEEPING REGARDING REQUESTS FOR CANADA GOOSE DAMAGE MANAGEMENT ASSISTANCE

WS maintains a Management Information System (MIS) database to document assistance that the agency provides in addressing wildlife damage conflicts. MIS data is limited to information that is collected from people who have requested services or information from Wildlife Services. It does not include requests received or responded to by local, State or other Federal agencies, and it is not a complete database for all wildlife damage occurrences. The number of requests for assistance does not necessarily reflect the extent of need for action, but this data does provide an indication that needs exists.

The database includes, but not limited to, the following information: species of wildlife involved, the number of individuals involved in a damage situation; tools and methods used or recommended to alleviate the conflict; and the resource that is in need of protection. Table 3 provides a summary of Technical Assistance projects completed by the NC WS program for Fiscal Years 1998-2002. A description of the WS Technical Assistance program in NC is described in Chapter 3 of this EA.

1.5 RELATIONSHIP OF THIS ENVIRONMENTAL ASSESSMENT TO OTHER ENVIRONMENTAL DOCUMENTS

WS conducted a NEPA process and developed a Final Environmental Impact Statement (FEIS) on the national APHIS/WS program (USDA 1997). The FEIS contains detailed discussions of potential environmental impacts from various wildlife damage management methods. Pertinent information available in the FEIS has been incorporated by reference into this EA. The FEIS may be obtained by contacting: USDA APHIS WS Operational Support Staff, 4700 River Rd., Unit 87, Riverdale, MD 20737-1234.

1.6 DECISIONS TO BE MADE

Based on the scope of this EA, the decisions to be made are:

- Should WS implement a Canada Goose Damage Management program in North Carolina?
- If not, how should WS fulfill its legislative responsibilities for management of damage and conflicts associated with Canada geese in North Carolina?
- Might the proposed WS program have significant impacts requiring preparation of an EIS?

1.7 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

1.7.1 Actions Analyzed

This EA evaluates Canada goose damage management by WS to protect human health, human safety, property, natural resources and agriculture on private land or public facilities whenever or wherever such management is requested from the WS program in North Carolina.

1.7.2 American Indian Lands and Tribes.

Currently WS does not have any MOUs or signed agreements with any American Indian tribe in North Carolina. If WS enters into an agreement with a tribe, this EA would be reviewed and supplemented if appropriate to insure compliance with NEPA.

1.7.3 Period for Which this EA is Valid

This EA will remain valid until WS determines that new needs for action or new alternatives having different environmental effects must be analyzed. At that time, this analysis and document will be reviewed and revised as necessary. This EA will be reviewed each year to ensure that it is complete and still appropriate to the scope of WS state Canada goose damage management activities.

1.7.4 Site Specificity

This EA analyzes the potential impacts of WS' Canada goose damage management activities and addresses activities on all lands in North Carolina under MOU, Cooperative Agreement and in cooperation with the appropriate public land management agencies. It also addresses the impacts of Canada goose damage management activities on areas where additional agreements may be signed in the future. Because the proposed action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional Canada goose damage management efforts could occur. Thus, this EA anticipates this potential expansion and analyzes the impacts of such efforts as part of the program.

Planning for the management of goose damage must be viewed as being conceptually similar to federal or other agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, insurance companies, etc. Although some of the sites where bird damage will occur can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. This EA emphasizes major issues as they relate to specific areas whenever possible, however, many issues apply wherever goose damage and resulting management occurs, and are treated as such. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS in North Carolina (see Chapter 3 for a description of the Decision Model and its application).

The analyses in this EA are intended to apply to any action that may occur *in any locale* and at *any time* within the analysis area. In this way, APHIS-WS believes it meets the intent of NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with NEPA and still be able to accomplish its mission.

1.7.5 Public Involvement/Notification.

As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS-NEPA implementing regulations, this document and its Decision are being made available to the public through "Notices of Availability" (NOA) published in local media and through direct mailings of NOA to parties that have specifically requested to be notified. New issues or alternatives raised after publication of public notices will be fully considered to determine whether the EA and its Decision should be revisited and, if appropriate, revised.

1.8 AUTHORITY AND COMPLIANCE

1.8.1 Authority of Federal and State Agencies in Canada Goose Damage Management in North Carolina

See Chapter 1 of USDA (1997) for a complete discussion of federal laws pertaining to WS.

1.8.1.1 WS Legislative Authority

The USDA is directed by law to protect American agriculture and other resources from damage associated with wildlife. The primary statutory authority for the Wildlife Services program is the Act of 1931, as amended (7 U.S.C. 426-426c; 46 Stat. 1468); the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988 (P.L. 100202); and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 2001, Public Law 106-387, October 28, 2000. Stat. 1549 (Sec 767), which provides that:

> *"The Secretary of Agriculture may conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program. The Secretary shall administer the program in a manner consistent with all of the wildlife services authorities in effect on the day before the date of the enactment of the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2001."*

Since 1931, with the changes in societal values, WS policies and programs place greater emphasis on the part of the Act discussing "bringing (damage) under control," rather than "eradication" and "suppression" of wildlife populations. In 1988, Congress strengthened the legislative authority of WS with the Rural Development, Agriculture, and Related Agencies Appropriations Act. This Act states, in part:

> *"That hereafter, the Secretary of Agriculture is authorized, except for urban rodent control, to conduct activities and to enter into agreements with states, local jurisdictions, individuals, and public and private agencies, organizations, and institutions in the control of nuisance mammals and birds and those mammal and bird species that are reservoirs for zoonotic diseases, and to deposit any money collected under any such agreement into the appropriation accounts that incur the costs to be available immediately and to remain available until expended for Animal Damage Control activities."*

1.8.1.2 U.S. Fish and Wildlife Service (USFWS)

The USFWS is responsible for managing and regulating take of bird species that are listed as migratory under the MBTA and those that are listed as T&E species under the ESA. Sections 1.8.2.2 and 1.8.2.3 below describe WS interactions with the USFWS under these

two laws. Under the permitting application process, the USFWS requires applicants to describe prior non-lethal damage management techniques that have been used.

1.8.1.3 North Carolina Wildlife Resources Commission Legislative Mandate

The NCWRC, under the direction of the Governor-appointed Board of Directors, is specifically charged by the General Assembly with the management of the state's wildlife resources. Although many legal mandates of the Board and the Department are expressed throughout the NC Annotated Code (NCAC), the primary statutory authority is given in Chapter 113, Subchapter IV, Article 22, which states "The...Wildlife Resources of the State belong to the people of the State as a whole. The...Wildlife Resources Commission [is] charged with stewardship of these resources." Elsewhere in this Chapter, the Commission is specifically given powers related to the take, possession, buying and selling of wildlife. Under this authority, the Commission has adopted rules in the NCAC implementing these powers and providing for the stewardship of wildlife resources of the state (C. Betsill, NCWRC, pers. comm.).

1.8.1.4 Authority of Federal Agencies in Wildlife Damage Management in North Carolina

Through a Memorandum of Understanding (MOU), Wildlife Services has established a cooperative relationship with the NCWRC. This MOU establishes a cooperative relationship between North Carolina WS and NCWRC for planning, coordinating and implementing wildlife damage management policies in North Carolina. WS is obligated to conduct control activities under the applicable Federal, State, and local laws and regulations.

1.8.2 Compliance with Other Federal Laws

Several other federal laws authorize, regulate, or otherwise affect WS wildlife damage management. WS complies with these laws, and consults and cooperates with other agencies as appropriate.

1.8.2.1 National Environmental Policy Act (NEPA)

WS prepares analyses of the environmental impacts of program activities to meet procedural requirements of this law. This EA meets the NEPA requirement for the proposed action in North Carolina. When WS direct management assistance is requested by another federal agency, NEPA compliance is the responsibility of the other federal agency. However, WS could agree to complete NEPA documentation at the request of the other federal agency.

1.8.2.2 Endangered Species Act (ESA)

It is federal policy, under the ESA, that all federal agencies shall seek to conserve T&E species and shall utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "any action authorized, funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency shall use the best scientific and commercial data available" (Sec.7(a)(2)). WS obtained a Biological Opinion (B.O.) from the U.S. Fish and Wildlife Service (USDI 1992) describing potential effects on T&E species and prescribing reasonable and prudent measures for avoiding jeopardy (USDA 1997, Appendix F).

1.8.2.3 Migratory Bird Treaty Act of 1918 (U.S.C. 703711: 40 Stat. 755), as amended

The MBTA provides the USFWS regulatory authority to protect families of birds that contain species which migrate outside the United States. The law prohibits any "take" of these species by private entities, except as permitted by the USFWS; therefore the USFWS issues permits to private entities for reducing bird damage. WS will obtain MBTA permits covering Canada goose damage management activities that involve the taking of species for which such permits are required in accordance with the MBTA and USFWS regulations, or will operate as a named agent on MBTA permits obtained by cooperators.

1.8.2.4 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The U. S. Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All pesticides used by the WS program in North Carolina are registered with and regulated by the EPA and North Carolina Department of Agriculture (NCDA), and are used by WS in compliance with labeling procedures and requirements. No toxicants are currently used or registered for use in managing geese or reducing goose damage. The repellent ReJeX-iT AG-36™ is registered for use in reducing goose damage to vegetation in North Carolina as well as FlightControl ®, developed as a means to deter geese from congregating in and around residential communities, athletic fields, parks and recreational facilities, office, and commercial complexes, and golf courses.

1.8.2.5 Investigational New Animal Drug (INAD)

The drug alpha chloralose (AC) has been used as a sedative for animals and is registered with the Food and Drug Administration (FDA) to capture waterfowl, coots, and pigeons. FDA approval for use under INAD (21 CFR, Part 511) authorized WS to use the drug as a nonlethal form of capture.

1.8.2.6 Clean Water Act (Section 404)

Section 404 (33 U.S.C. 1344) of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE unless the

specific activity is exempted in 33 CFR 323 or covered by a nationwide permit in 33 CFR 330. A landowner/manger may be required to obtain a section 404 permit for certain aquatic habitat alteration practices.

1.8.2.7 National Historic Preservation Act (NHPA) of 1966, as amended

The National Historic Preservation Act (NHPA) of 1966, and its implementing regulations (36 CFR§800), requires federal agencies to: 1) determine whether activities they propose constitute "undertakings" that can result in changes in the character or use of historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian Tribes to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings. WS actions on tribal lands are only conducted at the tribes request and under signed agreement; thus, the tribes have control over any potential conflict with cultural resources on tribal properties. WS activities as described under the proposed action do not cause ground disturbances nor do they otherwise have the potential to significantly affect visual, audible, or atmospheric elements of historic properties and are thus not undertakings as defined by the NHPA. Canada goose damage management could benefit historic properties if such properties were being damaged by geese. In those cases, the officials responsible for management of such properties would make the request and would select the methods to be used in their Canada goose damage management program. Harassment techniques that involve noise making could conceivably disturb users of historic properties if they were used at or in close proximity to such properties; however, it would be an exceedingly rare event for noise producing devices to be used in close proximity to such a property unless the resource being protected from goose damage was the property itself, in which case the primary effect would be beneficial. Also, the use of such devices is generally short term and could be discontinued if any conflicts with historic properties arose. WS has determined Canada goose damage management actions are not undertakings as defined by the NHPA because such actions do not have the potential to result in changes in the character or use of historic properties.

1.8.2.8 Environmental Justice and Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations."

Executive Order 12898, entitled, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" promotes the fair treatment of people of all races, income levels and cultures with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Environmental Justice is a priority within APHIS and WS. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies and activities on minority and low income persons or populations.

APHIS implements Executive Order 12898 principally through its compliance with NEPA. All WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898. WS personnel use only legal, effective, and environmentally safe wildlife damage management methods, tools, and approaches. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minority and low income persons or populations.

1.8.2.9 Protection of Children from Environmental Health and Safety Risks (Executive Order 13045)

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children, WS has considered the impacts that this proposal might have on children. The proposed Canada goose damage management program would occur by using only legally available and approved methods where it is highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing this proposed action. Additionally, since the proposed Canada goose damage management program is directed at reducing accumulations of feces, goose aggression, denuding of landscaped vegetation, etc., at schools, public parks, playgrounds, private properties and other locations where children are sometimes present, it is expected that health and safety risks to children would be reduced.

1.8.2.10 Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 requires each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations, is directed to develop and implement, a Memorandum of Understanding (MOU) with the USFWS that shall promote the conservation of migratory bird populations. WS has developed a draft MOU with the USFWS as required by this Executive Order and is currently waiting for USFWS approval. WS will abide by the MOU once it is finalized and signed by both parties.

1.8.3 Compliance with Other State Laws

Wildlife Taken For Depredations or Accidentally

NCAC 10B.0106 allows for the taking of wildlife, including state and threatened and endangered species, for damage management purposes under Special Depredation Permits and the disposal of said wildlife either on the property or at another location in a safe and sanitary manner. It also allows for the accidental take and disposal of nontarget animals while conducting damage management (C. Betsill, NCWRC, pers. comm.).

2.0 CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

Chapter 2 contains a discussion of issues that received detailed environmental impact analysis in Chapter 4 (Environmental Consequences) and issues not considered in detail, with rationale. Portions of the affected environment will be included in this chapter in the discussion of issues used to develop mitigation measures. Additional affected environments are incorporated into the discussion of the environmental impacts in Chapter 4 and the description of the current program in Chapter 3.

2.1 AFFECTED ENVIRONMENT

The areas of the proposed action include, but are not limited to, property on or adjacent to airports, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, schools, agricultural areas, wetlands, restoration sites, and cemeteries. The proposed action may be conducted on properties held in private, local, state or federal ownership.

2.2 ISSUES

The following issues have been identified as areas of concern requiring consideration in this EA. These will be analyzed in detail in Chapter 4:

1. Effects on Target Canada Goose Populations
2. Effectiveness of Canada Goose Damage Management
3. Effects on Aesthetic Values
4. Humaneness and Animal Welfare Concerns of Methods Used by WS
5. Effects on Nontarget Wildlife Species Populations, Including T&E Species

2.3 ISSUES ADDRESSED IN THE ANALYSIS OF ALTERNATIVES

2.3.1 Effects on Target Canada Goose Populations

A common concern among members of the public is whether wildlife damage management actions adversely affect the viability of target wildlife species populations. The target species analyzed in this EA is the Canada goose.

2.3.2 Effectiveness of Canada Goose Damage Management

Another common concern among members of the public is whether the methods of reducing Canada goose damage will be effective in reducing or alleviating the damage/conflict. The effectiveness of each alternative can be defined in terms of decreased potential for health risks, decreased human safety hazards, reduced property damage, reduced agricultural damage, reduced natural resource damage and improved quality of life.

2.3.3 Affects on Aesthetic Values

Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetic values are subjective, and depend on what an observer regards as beautiful.

Generally, wildlife is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit for many people. However, wildlife may also be responsible for adverse affects to people. The activities of some wildlife result in economic losses to agriculture and damage to property. Human safety is jeopardized by wildlife collisions with aircraft and automobiles, aggressive goose behavior sometimes results in human injury, and wild animals may harbor diseases transmissible to humans.

Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). These include direct benefits related to consumptive and nonconsumptive use (e.g., wildlife related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (e.g., reading, television viewing), and the personal enjoyment of knowing wildlife exists and is a part of the stability of natural ecosystems (e.g., ecological, existence, bequest values) (Bishop 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is the knowledge that the animals exist (Decker and Goff 1987). Positive values of wildlife would also include having enough wildlife to view. However, the same wildlife populations that are generally appreciated may also create conflicts with land uses and human health and safety. Certain species of wildlife can be regarded as a nuisance in certain settings. Large numbers of Canada geese can reduce the aesthetic appearance and enjoyment of some activities and locations because of excessive feces, goose aggression and human injury, denuded vegetation, eroded streambanks, disruption of vehicle traffic, etc. In sum, aesthetics include those values people place on Canada geese, knowledge of their existence and occurrence in their area, ability to enjoy and use properties for their intended purpose without excessive feces present, and ability to enjoy the natural and landscaped vegetation of an area.

Public reaction is variable and mixed among people because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to reduce conflicts/problems between humans and wildlife. Population management methods (egg destruction, capture and relocation, capture and euthanize, and shooting) may provide relief from damage in situations where nonlethal methods were ineffective or impractical. Many people directly affected by damage to property and threats to human safety caused by Canada geese choose removal of geese from the property when the WAC has been exceeded. Some people believe that waterfowl should be captured and relocated to another area to alleviate damage or threats to human safety. Some people directly affected by the damage from Canada geese sometimes oppose removal of the birds regardless of the amount of damage. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to removal of geese from specific locations or sites. Some of the totally opposed people want WS to teach tolerance for Canada goose damage and threats to human health and safety, and that Canada geese should never be killed. Some of the people who oppose removal of Canada geese do so because of human affectionate bonds with individual geese. These human affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Some wildlife species habituate easily and live in close proximity to humans. Some people in these situations feed wildlife and/or otherwise develop emotional attitudes toward the animals that result in aesthetic enjoyment. In addition, some people consider individual wild birds as "pets," or exhibit affection toward these animals. Examples would be people who visit a city park to feed geese and homeowners who have bird feeders or bird houses. Many people do not develop emotional bonds with individual wild animals, but experience aesthetic enjoyment from observing them.

Some property owners that have populations of geese above their identified WAC are concerned about the negative aesthetic appearance of feces and property damage to landscaping and turf. Managers of golf courses, swimming beaches and athletic fields are particularly concerned because negative aesthetics can result in reduced public use.

2.3.4 Humaneness and Animal Welfare Concerns of Methods used by WS

Humaneness, in part, is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently.

Research indicates that the public may be willing to accept lethal wildlife management methods if they are humane (ie, minimize pain and suffering of the target animal) (Kellert 1993, Schwartz et al. 1997). The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife, is an important and complex concept. Wildlife damage management for societal benefits could be compatable with animal welfare concerns if ". . . *the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process" (Schmidt 1989).* Suffering is described as a "*. . . highly unpleasant emotional response usually associated with pain and distress*", however, suffering "*. . . can occur without pain . . .*," and "*. . . pain can occur without suffering . . .* " (AVMA 1987). Because suffering carries with it the implication of a time frame, suffering is considered to be minimized where death is immediate (CDFG 1991) such as occurs with proper shooting.

Defining pain as a component in humaneness of WS methods is a greater challenge than that of suffering. Pain occurs in animals. Altered physiology and behavior can be indicators of pain, and the causes that elicit pain responses in humans would "*. . . probably be causes for pain in other animals . . .* " (AVMA 1987). Pain experienced by individual animals probably ranges from little or no pain to significant pain (CDFG 1991). One challenge with coping with this issue is how to achieve the least amount of animal suffering within the constraints of current technology and resources. Additionally, "*. . . neither medical or veterinary curricula explicitly address suffering or its relief*" (AVMA 1987, CDFG 1999).

WS has improved the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some Canada goose damage management methods are used.

WS personnel in North Carolina are experienced and professional in their use of management methods so that they are as humane as possible under the constraints of current technology, workforce and funding. Mitigation measures and standard operating procedures used to maximize humaneness are listed in Chapter 3.

2.3.5 Effects on Nontarget Wildlife Species Populations, Including T&E Species

WS, other wildlife professionals, and the public are concerned about the potential impact of damage management methods and activities on nontarget species, particularly threatened and endangered (T&E) species. WS's standard operating procedures include measures intended to mitigate or reduce the effects on nontarget and T&E species populations and are presented in Chapter 3.

2.4 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

2.4.1 Appropriateness of Preparing an EA (Instead of an EIS) For Such a Large Area

Some individuals might question whether preparing an EA for an area as large as the State of North Carolina would meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of federal or other agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to accurately describe such locations or times in an EA or EIS. The WS program is analogous to other agencies or entities with damage management missions such as fire and police departments, emergency cleanup organizations, insurance companies, etc. Although WS can predict some of the possible locations or types of situations and sites where some kinds of wildlife damage will occur, the program cannot predict the specific locations or times at which affected resource owners will determine a damage problem has become intolerable to the point that they request assistance from WS. In addition, the WS program would not be able to prevent such damage in all areas where it might occur without resorting to destruction of wild animal populations over broad areas at a much more intensive level than would be desired by most people, including WS and state agencies. Such broad scale population management would also be impractical or impossible to achieve within WS policies and professional philosophies.

If a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared. In terms of considering cumulative impacts, one EA analyzing impacts for the entire state provides a better analysis than multiple EA's covering smaller zones.

3.0 CHAPTER 3: ALTERNATIVES INCLUDING THE PROPOSED ACTION

Alternatives were developed for consideration using the WS Decision Model (Slate et al. 1992) as described in Chapter 2 (pages 20-35), Appendix J (Methods of Control), Appendix N (Examples of WS Decision Model), and Appendix P (Risk Assessment of Wildlife Damage Control Methods Used by USDA, Wildlife Services Program) of the ADC FEIS (USDA 1997).

Chapter 3 contains a discussion of the project alternatives, including those that will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), alternatives considered but not analyzed in detail, with rationale, and mitigation measures and SOP's for wildlife damage management techniques. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop mitigation measures. Evaluation of the affected environments will be addressed in more detail in Chapter 4.

3.1 DESCRIPTION OF THE ALTERNATIVES

The No Action alternative is a procedural NEPA requirement (40 CFR 1502), is a viable and reasonable alternative that could be selected, and serves as a baseline for comparison with the other alternatives. The No Action alternative, as defined here, is consistent with the Council on Environmental Quality's (CEQ's) definition (CEQ 1981).

3.2 Canada Goose Damage Management Strategies and Methodologies Available to WS in North Carolina

The strategies and methodologies described below include those that could be used or recommended under Alternatives 1, 2, and 3 described in Section 3.3. Alternative 4 would terminate both WS technical assistance and operational wildlife damage management WS. Appendix B is a more thorough description of the methods that could be used or recommended by WS.

3.2.1 Integrated Wildlife Damage Management (IWDM).

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. The philosophy behind IWDM is to implement the best combination of effective management methods in a cost-effective[2] manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. IWDM may incorporate cultural practices (i.e., no feeding policies), habitat modification (i.e., exclusion), animal behavior modification (i.e., scaring), removal of individual offending animals, local population reduction, or any combination of these, depending on the circumstances of the specific damage problem. WS considers the biology and behavior of the damaging species and other factors using the WS Decision Model (Slate et al 1992). The recommended strategy(ies) may

[2] The cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

include any combination of preventive and corrective actions that could be implemented by the requester, WS, or other agency personnel, as appropriate. Two strategies are available:

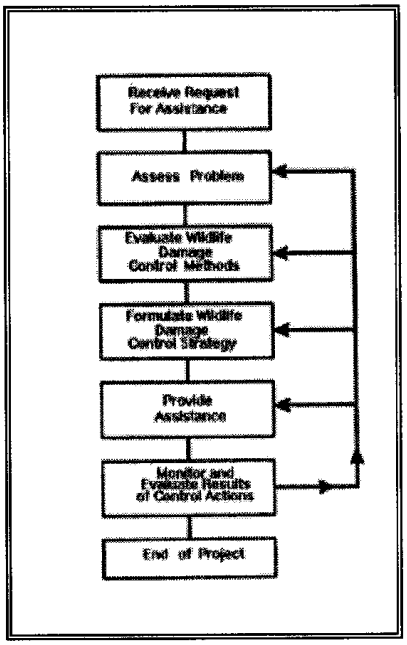
1. Preventive Damage Management is applying wildlife damage management strategies before damage occurs, based on historical problems and data. All non-lethal methodologies, whether applied by WS or resource owners, are employed to prevent damage from occurring and therefore fall under this heading. When requested, WS personnel provide information and conduct demonstrations, or take action to prevent additional losses from recurring. An example would be a cooperator installing and maintaining a fence and/or overhead wire grid system to reduce access of waterfowl to a retention pond or scaring waterfowl away from active runways.

2. Corrective Damage Management Corrective damage management is applying wildlife damage management to stop or reduce current losses. As requested and appropriate, WS personnel provide information and conduct demonstrations, or take action to prevent additional losses from recurring. An example would be the removal of waterfowl during the summer molt using round-up techniques or the oiling of eggs during the nesting season. Often, this involves the lethal removal of individual animals.

3.2.2 WS Decision Making

WS personnel use a thought process for evaluating and responding to damage complaints that is depicted by the WS Decision Model described by Slate et al. (1992) (Figure 3-1). WS personnel are frequently contacted after requesters have tried or considered non-lethal methods and found them to be impractical, too costly, or inadequate for reducing damage to an acceptable level. WS personnel assess the problem; evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, the methods deemed to be practical for the situation are developed into a management strategy. After the management strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the WS Decision Model (Slate et al. 1992), most damage management efforts consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not necessarily a documented process, but is a mental problem-solving process common to most if not all professions.

Figure 3-1
WS Decision Model



3.2.3 The IWDM Strategies that WS Employs

Technical Assistance Recommendations (implementation is the responsibility of the requestor):

Technical assistance is information, demonstrations, and advice on available and appropriate wildlife damage management methods. Technical assistance may require substantial effort by WS personnel in the decision making process, but the implementation of damage management actions is the responsibility of the requester. In some cases, WS provides supplies or materials that are of limited availability for non-WS entities to use. Technical assistance may be provided following a personal or telephone consultation, or during an on-site visit with the requester. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems, these strategies are based on the level of risk, need, and the practicality of their application.

Under APHIS' NEPA Implementing Regulations and specific guidance for the WS program, WS technical assistance is categorically excluded from the need to prepare an EA or EIS. However, it is discussed in this EA because it is an important component of the IWDM approach to resolving wildlife damage problems.

Direct Damage Management Assistance (implementation is conducted or supervised by WS personnel):

Direct damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone, and when *Agreements for Control* or other comparable

instruments provide for WS direct control damage management. The initial investigation defines the nature, history, extent of the problem, species or property directly and indirectly damaged, species responsible for the damage, and methods that would be available to resolve the problem. Professional skills of WS personnel are often required to effectively resolve problems, especially if restricted use pesticides are necessary, or if the problem is complex. Direct damage management provided by WS in North Carolina is provided on a cost reimbursable (contract) basis.

Educational Efforts:

Education is an important element of WS program activities because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather, is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, lectures and demonstrations are provided to producers, homeowners, state and county agents, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS personnel, other wildlife professionals, and the public are periodically updated on recent developments in damage management technology, laws and regulations, and agency policies.

Research and Development:

The National Wildlife Research Center (NWRC) functions as the research arm of WS by providing scientific information and development of methods for wildlife damage management that are effective and environmentally responsible. NWRC scientists work closely with wildlife managers, researchers, field specialists and others to develop and evaluate wildlife damage management techniques. NWRC research was instrumental in the development of methyl anthranilate. In addition, NWRC is currently testing new experimental drugs that inhibit bird reproduction. NWRC scientists have authored hundreds of scientific publications and reports, and are respected worldwide for their expertise in wildlife damage management.

3.2.4 Community Based Decision Making

Technical assistance provided by Wildlife Services to resource owners for decision making.

The WS program in North Carolina follows the "co-managerial approach" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS provides technical assistance regarding the biology and ecology of Canada geese and effective, practical, and reasonable methods available to the local decision maker(s) to reduce wildlife damage. This includes nonlethal and lethal methods. WS and other state and federal wildlife or wildlife damage management agencies may facilitate discussions at local community meetings when resources are available. Resource owners and others directly affected by goose damage or conflicts have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request management assistance

from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Local decision makers decide which effective methods should be used to solve wildlife-related conflicts. These decision makers include community leaders, private property owners/managers, and public property owners/managers.

Community decision makers.

The decision maker for the local community with a homeowner or civic association would be the President or the President's or Board's appointee. The President and Board are popularly elected residents of the local community who oversee the interests and business of the local community. This person would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision making. Identifying the decision maker for local business communities is more complex because the lease may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. WS would provide technical assistance to the local community or local business community decision maker(s) and recommendations to reduce damage. Direct control would be provided by WS if requested by the local community decision maker, funding provided, and the requested direct control was compatible with WS recommendations.

Private property decision makers

The decision maker for private property owned by one person is him or herself. WS would provide technical assistance to this person and recommendations to reduce damage. Direct control would be provided by WS if requested, funding provided, and the requested direct control was in line with WS recommendations.

Public property decision makers

The decision maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals and legal mandates for the property. WS would provide technical assistance to this person and recommendations to reduce damage. Direct control would be provided by WS if requested, funding provided, and the requested direct control was in line with WS recommendations.

Summary for community based decision making

The process for involving local communities and local stakeholders in the decisions for Canada goose damage management assures that local concerns are considered before individual damage management actions are taken.

3.2.5 Wildlife Damage Management Methods Available For Use or Recommendation by WS. (Appendix B contains detailed descriptions of Canada goose damage management methodologies)

Non-lethal methods

Property owner practices consist primarily of non-lethal preventive methods such as cultural methods[3] and habitat modification.

Animal behavior modification refers to tactics that alter the behavior of wildlife to reduce damages. Some but not all of these tactics include:

- Exclusion such as fencing/overhead wires
- Propane cannons (to scare Canada geese)
- Pyrotechnics (to scare Canada geese)
- Distress calls and sound producing devices (to scare Canada geese)
- Visual repellents and scaring tactics
- Dogs (to scare geese)

Nest destruction of the target species before eggs or young are in the nest.

Habitat/environmental modification to attract or repel certain waterfowl species.

Live traps are various types of traps designed to capture geese. Some examples are panel nets used for capturing geese during the summer molt, rocket and cannon nets, clover traps, decoy traps, hand nets, etc.

Alpha-chloralose, a central nervous system depressant, is used as an immobilizing agent to capture waterfowl or other birds. It is generally used in recreational and residential areas, such as swimming pools, shoreline residential areas, golf courses, or resorts. Alpha-chloralose is typically delivered as a well-contained bait in small quantities with minimal hazards to pets and humans; single bread or corn baits are fed directly to the target birds.

Methyl Anthranilate (MA) (artificial grape flavoring food additive) has been shown to be an effective repellent for many bird species, including waterfowl. It can be applied to turf or surface water or as a fog to repel birds from small areas.

Anthraquinone is a non-restricted chemical bird repellent that could be used to reduce feeding activity on airfields, residential communities, athletic fields, parks and recreational facilities, office and commercial complexes, golf courses, and other areas. Antraquinone is a bio-pesticide that is

[3] Generally involves modifications to the management of protected resources to reduce their vulnerability to wildlife damage.

non-lethal and works by causing a negative response to feeding in the treated area (Avery et al. 1997).

Lethal Methods

Shooting is the selective removal of target species by shooting with an air rifle, shotgun, or rifle. Shooting a few individuals from a larger flock can reinforce birds' fear of harassment techniques.

Cervical dislocation is sometimes used to euthanize birds that are captured in live traps. AVMA approves this technique as a humane method of euthanasia and states that cervical dislocation when properly executed is a humane technique for euthanasia of poultry and of small birds (Beaver et al. 2001).

Where safe and legal, **sport hunting** is sometimes recommended when target species can be hunted. All waterfowl hunters are requires to possess a State hunting license and waterfowl stamp, and a Federal Migratory Bird Stamp. Before hunting, check local ordinances regarding the discharge of firearms.

Egg treatment/destruction is the practice of ceasing the development of the egg prior to hatching (egg oiling, chilling, shaking, puncturing); physically breaking eggs; or directly removing eggs from a nest and destroying them.

Carbon dioxide (CO2) gas is an American Veterinary Medical Association (AVMA) approved euthanasia method (Beaver et al. 2001) which is sometimes used to euthanize birds which are captured in live traps or by chemical immobilization. Live animals are placed in a container or chamber into which CO2 gas is released. The animals quickly expire after inhaling the gas.

3.3 Alternatives Analyzed in Detail in Chapter 4

3.3.1 Alternative 1: Integrated Wildlife Damage Management (Proposed Action/No Action)

The proposed action is for WS to continue to implement an Integrated Canada Goose Damage Management Program that responds to requests for the protection of property, agricultural resources, natural resources, quality of life, human health, and human safety in North Carolina. Requests for assistance may occur anywhere and anytime throughout the state. The program would include the use of legal techniques and methods, used singly or in combination, to meet requestor needs for reducing conflicts with Canada geese (Appendix B). Cooperators requesting assistance would be provided with information regarding the use of effective nonlethal and lethal techniques. Nonlethal methods recommended and used by WS may include resource management, physical exclusion, relocation, and deterrents. Lethal methods recommended and used by WS may include nest/egg destruction, live capture and transportation to a licensed poultry processing facility, live capture and euthanasia, and/or shooting. In many situations, the implementation of nonlethal methods such as manipulation of habitat, application of repellents, and installation of fencing, flagging, and exclusion devices would be conducted by the requestor. Wildlife damage management assistance regarding Canada geese would be conducted by WS in North Carolina,

when requested, on private and public property and facilities where a need exists and pursuant to an Agreement for Control.

The proposed program would be conducted pursuant to applicable laws and regulations authorizing take of Canada geese and their nest and eggs, developed through partnerships among WS, the USFWS, and the NCWRC, and as requested by and through coordination with requestors of assistance. All management actions would comply with applicable federal, state, and local laws.

3.3.2 Alternative 2: Technical Assistance Only by WS

This alternative would not allow for WS operational Canada goose damage management in North Carolina. WS would only continue to provide technical assistance and make recommendations when requested. Producers, property owners, agency personnel, or others could conduct Canada goose damage management using any legal lethal or nonlethal method. Currently, alpha-chloralose is only available for use by WS employees. Therefore, use of this chemical by private individuals would be illegal and unavailable for use. Appendix B describes a number of methods that could be employed by private individuals or other agencies after receiving technical assistance advice under this alternative.

3.3.3 Alternative 3: Nonlethal Only by WS

This alternative would require WS to use or recommend nonlethal methods only to resolve Canada goose damage problems. Persons receiving technical assistance could still employ lethal methods that were available to them. Currently, alpha-chloralose is only available for use by WS employees. Therefore, use of this chemical by private individuals would be illegal. Appendix B describes a number of nonlethal methods available for use by WS under this alternative.

3.3.4 Alternative 4: No Federal WS Canada Goose Damage Management

This alternative would eliminate WS involvement in Canada goose damage management in North Carolina. WS would not provide direct operational or technical assistance and requesters of WS services would conduct damage management activities without WS input. Information on Canada goose damage management methods may be available to producers and property owners through other sources such as the NCWRC, USDA Agricultural Extension Service offices, universities, or pest control organizations. Alpha-chloralose is only available for use by WS employees. Therefore, use of this chemical by private individuals would be illegal and unavailable for use.

3.4 ALTERNATIVES ELIMINATED FROM FURTHER DISCUSSION WITH RATIONALE

3.4.1 Nonlethal Methods Implemented Before Lethal Methods

This alternative is similar to Alternative 1 except that WS personnel would be required to always recommend or use nonlethal methods prior to recommending or using lethal methods to reduce Canada goose damage. Both technical assistance and direct damage management would be

provided in the context of a modified IWDM approach. Alternative 1, the Proposed Action, recognizes nonlethal methods as an important dimension of IWDM, gives them first consideration in the formulation of each management strategy, and recommends or uses them when practical before recommending or using lethal methods. However, the important distinction between the Nonlethal Methods First Alternative and the Proposed Alternative is that the former alternative would require that all nonlethal methods be used before any lethal methods are recommended our used.

While the humaneness of the nonlethal management methods under this alternative would be comparable to the Proposed Program Alternative 1, the extra harassment caused by the required use of methods that may be ineffective could be considered less humane. As local Canada goose population increase, the number of areas negatively affected by geese would increase, and greater numbers of geese would be expected to congregate at sites where nonlethal management efforts were not effective. This may ultimately result in a greater numbers of geese being killed to achieve the local WAC than if lethal management were immediately implemented at problem locations (Manuwal 1989). Once lethal measures were implemented, Canada goose damage would be expected to drop relative to the reduction in localized population of Canada geese causing damage.

Since in many situations this alternative would result in greater numbers of geese being killed to achieve the local WAC, at a greater cost to the requester, and result in a delay in reaching the local WAC in comparison to the Proposed Alternative, the Nonlethal Methods Implemented Before Lethal Methods Alternative is removed from further discussion in this document.

3.5 MITIGATION AND STANDARD OPERATING PROCEDURES FOR WILDLIFE DAMAGE MANAGEMENT TECHNIQUES

3.5.1 Mitigation in Standard Operating Procedures

Mitigation measures are any features of an action that serve to prevent, reduce, or compensate for impacts that otherwise might result from that action. The current WS program, nationwide and in North Carolina, uses many such mitigation measures and these are discussed in detail in Chapter 5 of USDA (1997). Some key mitigating measures pertinent to the proposed action and alternatives that are incorporated into WS's standard operating procedures include:

- The WS Decision Model would be used to identify effective wildlife damage management strategies and their impacts (Slate et al. 1992).
- Reasonable and prudent measures or alternatives would be identified through consultation with the USFWS and are implemented to avoid impacts to T&E species.

Some additional mitigating factors specific to the proposed program include:

- Management actions would be directed toward localized populations or groups of target species and/or individual offending members of those species.

- WS uses Canada goose damage management devices and conducts activities for which the risk of hazards to public safety and hazard to the environment have been determined to be low according to a formal risk assessment (USDA 1997, Appendix P). Where such activities are conducted on private lands or other lands of restricted public access, the risk of hazard to the public is even further reduced.

3.5.2 Additional Mitigation Specific to the Issues

The following is a summary of additional mitigation measures that are specific to the issues listed in Chapter 2 of this document.

3.5.2.1 Effects on Target Species Populations

- Canada goose damage management is directed to resolve Canada goose damage problems by taking action against individual problem birds, or local populations or groups, not by attempting to eradicate or reduce goose populations in the entire area or region.
- To ensure that methods of live capturing Canada geese result in minimal pain, which could be measured as physical injury (e.g., bleeding, broken wing), captured birds would be made as comfortable as possible by watering the birds as necessary, not overcrowding the birds if they are put in holding cages for transportation, and seeking shade for caged birds as necessary.
- WS take is monitored by comparing numbers of birds killed with overall populations or trends in populations.

3.5.2.2 Effects on Non-target Species Populations Including T&E Species

- WS personnel are trained and experienced to select the most appropriate method for taking problem animals and excluding non-target wildlife.
- Observations are made to determine if non-target or T&E species would be at substantial risk from Canada goose damage management activities.
- WS has consulted with the USFWS regarding potential impacts of damage management methods on T&E species, and abides by reasonable and prudent alternatives (RPAs) and/or reasonable and prudent measures (RPMs) established as a result of that consultation. For the full context of the Biological Opinion see Appendix F of USDA (1997).

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative for meeting the purpose of the proposed action. The chapter analyzes the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2. This section analyzes the environmental consequences of each alternative in comparison with the No Action alternative to determine if the real or potential effects would be greater, lesser, or the same.

The following resource values within the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. These resources will not be analyzed further.

Cumulative Effects: Discussed in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from methods employed, and including summary analyses of potential cumulative impacts to target and nontarget species, including threatened and endangered species.

Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and other materials, there are no irreversible or irretrievable commitments of resources.

Effects on sites or resources protected under the National Historic Preservation Act: WS Canada goose damage management actions are not undertakings that could adversely affect historic resources (See Section 1.8.2.6).

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

4.1.1 Effects on Target Canada Goose Species Populations

Analysis of this issue is limited to those species killed during WS Canada goose damage management actions. The analysis for magnitude of impact generally follows the process described in Chapter 4 of USDA (1997). Magnitude is described in USDA (1997) as "*. . . a measure of the number of animals killed in relation to their abundance.*" Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest data when available. Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage.

4.1.1.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

A common concern among members of the public is whether wildlife damage management actions adversely affect the viability of target species populations. WS maintains ongoing contact with USFWS and the NCWRC. The USFWS monitors the total take of Canada

geese from all sources and factors in survival rates from predation, disease, etc. Ongoing contact with USFWS and the NCWRC assures local, state and regional knowledge of wildlife population trends. Whenever possible, WS implements all non-lethal dispersal techniques available before lethal options are considered. In addition, WS is restricted from recommending depredation permits from September 1 to March 10 due to USFWS guidelines. While local populations of Canada geese may be reduced, compliance with applicable state and federal laws and regulations authorizing take of Canada geese and their nest and eggs, will ensure that the regional and statewide population will not be adversely affected. The Canada goose is the target species for analysis in this EA.

Resident Canada Geese

As described in Section 1.3, in 1998, the population of resident Canada geese in North Carolina was estimated to be 96,505 geese. Cumulative impacts of the proposed action on resident Canada geese are based upon the anticipated WS take, hunter harvest, and authorized take by other (non-WS) entities (farmers, municipalities, homeowners associations, etc.). The potential take of resident Canada geese by WS is expected to have no negative cumulative impact on the statewide or flyway resident Canada goose population.

Since 2001, WS has taken (shot or capture and euthanized) a total of 199 resident Canada geese and 85 goose eggs (contained in 23 nests) in NC. Based upon past requests for WS assistance and an anticipated increase in future requests for services, WS anticipates that no more than 5% of the resident goose population would likely be killed annually by WS in North Carolina under the proposed action. During the 2001 Early September and Late Winter Resident Canada goose hunting seasons the harvest of resident Canada geese in North Carolina was estimated at 10,500 in the September season, and 19,700 geese for the regular season , respectively (NCWRC 2001). For Calendar Year 2002 (January 1 through December 31 2002), the USFWS authorized 1,098 Depredation Permits (not including 5 unlimited take permits specifically written for airports) to North Carolina entities other than WS, enabling the permitted take of up to 1,098 geese by capture and euthanization or by shooting, and the destruction of up to 150 goose eggs (not including 47 unlimited take of eggs) and 30 goose nests (not including 44 unlimited destruction of nests). Using the 2001 hunter harvest, USFWS permitted take, WS anticipated kill of less than 5% of the population, and an increasing population trend and magnitude of WS impacts on the resident Canada goose population is considered to be very low. Furthermore this cumulative take would contribute positively to the state and Atlantic Flyway Council's resident goose population management objective of reduction from the current level (96,505 geese) to approximately 30,000 geese in North Carolina.

While local populations of resident Canada geese deemed above the WAC by the property owner or local community may be reduced, applicable state and federal laws and regulations authorizing take of Canada geese and their nest and eggs, including the USFWS and NCWRC permitting processes, would ensure that the statewide population would not

be reduced below the state and Atlantic Flyway population goal of 30,000 resident Canada geese (Atlantic Flyway Council 1999).

Migratory Canada geese

As described in Section 1.3, in 2001, there were approximately 9,309 wintering migratory Canada geese in North Carolina. Cumulative impacts of the proposed action on migratory Canada geese are based upon the anticipated WS take, hunter harvest, and authorized take by other (non-WS) entities. Based upon past requests for WS assistance and an anticipated increase in future requests for services, WS anticipates that no more than 1% of the migratory Canada goose population would be killed by WS annually under the proposed action. In addition, WS records indicate no work requests (0%) were performed during the October- March time frame from 1998 to the present; therefore a lethal take of 1% would be an unlikely occurrence. During the 2001 regular Canada goose hunting season the estimated harvest for North Carolina was 10,500 geese (NCWRC, 2001). Geese harvested during this season effect both resident and migratory goose populations. Using the scenario that all geese harvested during this season are migratory geese and that WS anticipates that the lethal take of migrant Canada geese by WS would likely not exceed 1% of the migratory population, the potential take of migratory Canada geese by WS is expected to have no negative cumulative impact on the statewide or flyway migratory Canada goose population. Migratory goose populations are relatively stable in the Atlantic Flyway and the magnitude of WS impacts on the migratory Canada goose populations is considered to be extremely low.

While local populations of migratory Canada geese deemed above the WAC by the landowner or local community may be reduced, applicable state and federal laws and regulations authorizing take of Canada geese, including the USFWS and the NCWRC permitting processes, under which management actions would be implemented would ensure that the statewide and flyway population would not be reduced below state and Atlantic Flyway population goals and objectives.

Therefore, WS has determined that WS Canada goose damage management program activities in North Carolina will have no cumulative adverse affects on the populations of migratory Canada geese in North Carolina or the Atlantic Flyway.

4.1.1.2 Alternative 2: Technical Assistance Only by WS

Under this alternative, WS would have no impact on target Canada goose populations in North Carolina because the WS program would not conduct any goose damage management activities and would provide advice only. Private efforts to reduce or prevent Canada goose damage and conflicts could increase, which could result in similar or even greater effects on those populations than the proposed action alternative. For the same reasons shown in the population effects analysis in Section 4.1.1.1, however, it is unlikely that target goose populations would be adversely impacted by implementation of this alternative. It is hypothetically possible that frustration caused by the inability to reduce

damage and associated losses could lead to illegal use of chemicals which could lead to real but unknown effects on goose populations. The tranquilizer alpha-chloralose is currently only available for use by WS employees and would not be available for use under this alternative. Effects and hypothetical risks of illegal killing of Canada geese under this alternative would probably be about the same as those under Alternative 3.

4.1.1.3 Alternative 3: Nonlethal Only By WS

Under this alternative, WS would not lethally take any target Canada geese because no lethal methods would be used. Although WS lethal take of Canada geese would not occur, it is likely that, without WS conducting some level of lethal Canada goose damage management activities, private Canada goose damage management efforts would increase, leading to potentially similar or even greater effects on target species populations than those of the proposed action alternative. For the same reasons shown in the population effects analysis in section 4.1.1.1, however, it is unlikely that target Canada goose populations would be adversely impacted by implementation of this alternative. It is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal use of other chemicals which could lead to real but unknown effects on target goose populations. Effects and hypothetical risks of illegal killing of geese under this alternative would probably be less than Alternative 4.

4.1.1.4 Alternative 4: No Federal WS Canada Goose Damage Management

Under this alternative, WS would have no impact on Canada goose populations in North Carolina. Private efforts to reduce or prevent damage and conflicts could increase, which could result in effects on target species populations to an unknown degree. Effects on target species under this alternative could be the same, less, or more than those of the proposed action depending on the level of effort expended by private persons. For the same reasons shown in the population effects analysis in Section 4.1.1.1 it is unlikely that target Canada goose populations would be adversely impacted by implementation of this alternative. It is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of geese and therefore could lead to real but unknown effects on target goose populations. The tranquilizer alpha-chloralose is currently only available for use by WS employees and would not be available for use under this alternative.

4.1.2 Effectiveness of Canada Goose Damage Management

4.1.2.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

This alternative would be more effective than any of the other alternatives in reducing or minimizing damage caused by Canada geese. Population limiting techniques (e.g., hunting, capture and euthanize, shooting, and nest/egg destruction) may have long term

effects and can slow population growth or even reduce the size of a goose population (Cooper and Keefe 1997).

This alternative would give WS the option to implement lethal management in response to human health and safety concerns and damage to property and other resources. This alternative would enhance WS's effectiveness and ability to address a broader range of damage problems. Repopulation of sites where lethal management methods were used would undoubtedly take place as long as suitable habitat exists in that area. However, the use of lethal management would reduce the number of damaging geese thereby enhancing the effectiveness of nonlethal methods (Smith et al. 1999). Kilpatrick and Walter (1999) reported that when an urban wildlife population above the WAC is reduced through lethal means, many residents subsequently experience reduced damage.

This alternative would likely reduce the potential for goose/aircraft collisions at airports and increase human safety. This has been demonstrated by Cooper (1991) who reported the removal of geese posing or likely to pose a hazard to air safety at airports considerably reduced the population of local geese, decreased the number of goose flights through airport operations airspace, and significantly reduced goose/aircraft collisions at Minneapolis-St. Paul International Airport. In addition, Dolbeer et al. (1993) demonstrated that an integrated approach (including removal of offending birds) reduced bird hazards at John F. Kennedy International Airport and substantially reduced bird collisions with aircraft by as much as 89%. Jensen (1996) also reported that an IWDM approach that incorporated removal of geese at O'Hare International Airport reduced goose/aircraft collisions by 80% during a 2 year period.

This alternative would also be more effective than Alternatives 2 or 3, which rely primarily on frightening or displacing geese from one location to another.

4.1.2.2 Alternative 2: Technical Assistance Only by WS

With WS technical assistance but no direct management, entities requesting Canada goose damage management would either take no action, which means conflicts and damage would likely continue or increase in each situation as goose numbers are maintained or increased, or implement WS recommendations for nonlethal and lethal control methods. Methods of frightening or discouraging Canada geese have been effective at specific sites. In most instances however, these methods have simply shifted the problem elsewhere (Conover 1984, Aguilera et al. 1991, and Swift 1998). Of the nonlethal techniques commonly used by the public to reduce conflicts with geese (e.g., feeding ban, habitat modification, live swan, methyl anthranilate, fencing, harassment with dogs, people or vehicles), only fencing was reported to have been highly effective (Cooper and Keefe 1997). Habitat modifications, while potentially effective, are poorly accepted, not widely employed, and may include reducing water levels in wetlands, which may not be biologically sound. Long term solutions usually require some form of local population management to stabilize or reduce goose population size (Smith et al. 1999). Goose population reduction activities would be limited to applicable state and federal laws and

regulations authorizing take of Canada geese, including legal hunting and take pursuant to Depredation Permits. However, individuals or entities that implement lethal management may not have the experience necessary to efficiently and effectively conduct the actions.

4.1.2.3 Alternative 3: Nonlethal Only By WS

Under this alternative, WS would be restricted to implementing and recommending only nonlethal methods in providing assistance with Canada goose damage problems. The success or failure of the use of nonlethal methods can be quite variable. Methods of frightening or discouraging geese have been effective at specific sites. In most instances however, these methods have simply shifted the problem elsewhere (Conover 1984, Aguilera et al. 1991, and Swift 1998). However, if WS is providing direct operational assistance in dispersing Canada geese, coordination with local authorities, who may assist in monitoring the birds' movements, is generally conducted to assure they do not reestablish in other undesirable locations. Of the nonlethal techniques commonly used by the public to reduce conflicts with geese (e.g., feeding ban, habitat modification, live swan, methyl anthranilate, fencing, harassment with dogs, people or vehicles), only fencing was reported to have been highly effective (Cooper and Keefe 1997). Habitat modifications, while potentially effective, are poorly accepted, not widely employed, and many include reducing water levels in wetlands, which may not be biologically sound. Long term solutions usually require some form of local population reduction to stabilize or reduce goose population size (Smith et al. 1999). Overall impacts would be similar to Alternative 2.

4.1.2.4 Alternative 4: No Federal WS Canada Goose Damage Management.

With no WS assistance, private individuals and community government officials would either take no action, which means the Canada goose damage and conflicts would likely continue or increase in each situation as goose numbers are maintained or increased, or implement their own nonlethal and lethal control methods. Impacts would be variable and dependent upon the actions taken by non-WS personnel.

4.1.3 Effects on Aesthetic Values

4.1.3.1 Effects on Human Affectionate-Bonds With Individual Birds and On Aesthetics

4.1.3.1.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

Some people who routinely enjoy, interact with, view or feed geese or individual geese would likely be disturbed by removal of such birds under the proposed program. People who have developed affectionate bonds with individual geese may feel sadness and anger if those particular geese were removed. WS is aware of such concerns and takes this into

consideration to mitigate these affects. WS might sometimes be able to mitigate such concerns by leaving certain birds which might be identified by interested individuals.

Some people have expressed opposition to the killing of any geese during Canada goose damage management activities. Under the proposed action, some lethal control of birds would likely take place and these persons would be opposed to such actions. However, many persons who voice opposition have no direct connection or opportunity to interact with, view or enjoy the particular birds that would be killed by WS's lethal control activities. Lethal control actions would generally be restricted to local sites and to small percentages of overall goose populations. Therefore, the species subjected to limited lethal control actions would remain common and abundant and would therefore continue to remain available for viewing and enjoyment by persons with that interest.

Lethal removal of Canada geese from airports should not affect the public's enjoyment of the aesthetics of the environment since airport properties are closed to the public. The ability to view and interact with geese at these sites is usually either restricted to viewing from a location outside boundary fences, or is forbidden.

4.1.3.1.2 Alternative 2: Technical Assistance Only by WS

Under this alternative, WS would not conduct any direct management, but would still provide technical assistance or self-help advice to persons requesting assistance with Canada goose damage. Some people who oppose direct management assistance in wildlife damage management by the government but favor government technical assistance would favor this alternative. Persons who have developed affectionate bonds with individual geese would not be affected by WS's activities under this alternative because the individual geese would not be killed or dispersed by WS. However, other private entities would likely conduct direct management assistance activities similar to those that would no longer be conducted by WS, resulting in impacts similar to the proposed action.

4.1.3.1.3 Alternative 3: Nonlethal Only By WS

Under this alternative, WS would not conduct any lethal wildlife damage management but could conduct nonlethal harassment of geese that were causing damage. Some people who oppose lethal control of wildlife by the government but are tolerant of government involvement in nonlethal wildlife damage management would favor this alternative. Persons who have developed affectionate bonds with individual geese would not be affected by the death of individual birds under this alternative, but might oppose dispersal of certain birds. As discussed in this Subsection under Alternative 1, WS might sometimes be able to mitigate such concerns by leaving certain geese which might be identified by interested individuals. In addition, the abundant populations of target Canada goose species in urban-suburban environments would enable people to continue to view them and to establish affectionate bonds with individual geese. Although WS would not perform any lethal activities under this alternative, other private entities would likely conduct Canada

goose damage management activities similar to those that would no longer be conducted by WS, resulting in impacts similar to the proposed action.

4.1.3.1.4 Alternative 4: No Federal WS Canada Goose Damage Management.

Under this alternative, WS would not conduct any lethal removal of Canada geese nor would the program conduct any harassment of birds. Some people who oppose any government involvement in wildlife damage management would favor this alternative. Persons who have developed affectionate bonds with individual geese would not be affected by WS's activities under this alternative. However, other private entities would likely conduct Canada goose damage management activities similar to those that would no longer be conducted by WS, resulting in impacts similar to the proposed action.

4.1.3.2 Effects On Aesthetic Values of Property Damaged by Canada Geese

4.1.3.2.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

Under this alternative, operational assistance in reducing Canada goose conflicts, in which feces from the birds accumulate, would improve aesthetic values of affected properties. In addition, individuals whose aesthetic enjoyment of other birds and the environment is diminished by the presence of Canada goose and goose feces will be positively affected by programs which result in reductions in the presence of Canada geese.

The dispersal of Canada geese by harassment and barriers can sometimes result in the birds causing the same or similar problems at the new location. If WS is providing direct operational assistance in dispersing such birds, coordination with local authorities, who may assist in monitoring the birds' movements, may be conducted to assure they do not reestablish in other undesirable locations.

4.1.3.2.2 Alternative 2: Technical Assistance Only by WS

Under this alternative, the lack of operational assistance in reducing Canada goose problems could result in an increase of potential adverse affects on aesthetic values. However, potential adverse affects would likely be less than those for Alternative 4, since WS would be providing technical assistance.

The dispersal of Canada geese by harassment and barriers can sometimes result in the birds causing the same or similar problems at the new location. If WS has only provided technical assistance to local residents or municipal authorities, coordination with local authorities to monitor the birds' movements to determine if birds become established in other undesirable locations may not be conducted, therefore increasing the potential of adverse effects to nearby property owners.

4.1.3.2.3 Alternative 3: Nonlethal Only By WS

Under this alternative, WS would be restricted to nonlethal methods only. Assuming property owners would choose to allow and pay for the implementation of these non-lethal methods, this alternative could result in Canada geese relocating to other sites where they would likely create or worsen similar problems for other property owners. Thus, this alternative would likely result in more property owners experiencing adverse effects on the aesthetic values of their properties than the proposed action alternative.

The dispersal of Canada geese by harassment and barriers can sometimes result in the birds causing the same or similar problems at the new location. If WS is providing direct operational assistance in dispersing such birds, coordination with local authorities, who may assist in monitoring the birds' movements, may be conducted to determine if they become established in other undesirable locations.

4.1.3.2.4 Alternative 4: No Federal WS Canada Goose Damage Management.

Under this alternative, the lack of any WS operational or technical assistance in reducing Canada goose problems would mean aesthetic values of some affected properties would continue to be adversely affected if the property owners were not able to reduce goose damage in some other way. In many cases, this type of aesthetic "damage" would worsen because property owners would not be able to resolve their problems and Canada goose numbers would continue to increase.

The dispersal of Canada geese by harassment and barriers can sometimes result in the birds causing the same or similar problems at the new location. Coordination with local authorities to monitor waterfowl movements, to determine if birds become established in other undesirable locations, may not be conducted, therefore increasing the potential of adverse effects to nearby property owners.

4.1.4 Humaneness and Animal Welfare Concerns of Methods Used by WS

4.1.4.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

Under this alternative, methods viewed by some persons as inhumane would be used by WS. These methods would include capture and euthanasia, capture and relocate, capture and processing for human consumption, egg treatments, immobilization with the use of AC, and shooting.

There would likely be concern among stakeholders, in situations where Canada geese are captured and euthanized or captured and processed for human consumption, that the birds should be killed quickly. Many stakeholders would want Canada geese captured in a way that results in no pain or a minimization of pain, which they could measure as physical injury (e.g., bleeding, broken wing). Captured birds would be made as comfortable as possible by watering the birds as necessary, not overcrowding the birds if they are put in

holding crates for transportation, and seeking shade for caged birds as necessary. Geese would be processed for human consumption in state licensed poultry processing facilities in accordance with all pertinent regulations.

There may be concern among stakeholders that birds sedated with alpha-chloralose should not be allowed to drown, even if the birds are to be euthanized. In situations where geese are being captured alive by use of alpha-chloralose, nets, or by hand, the birds would be euthanized by methods approved by the AVMA (Beaver et al. 2001). Most people would view AVMA approved methods of euthanizing animals as humane.

If geese are shot, stakeholders would likely want quick clean kills of shot birds. Some persons would view shooting as inhumane. Some people could also be concerned about eggs being oiled, punctured, chilled, or addled. Some individuals may consider the treatment of eggs as inhumane A minority of stakeholders would likely want no geese captured, harassed, or killed because they consider putting birds in crates as inhumane, and the killing of birds as inhumane regardless of the method used.

Some people have concerns over the potential for separation of goose family groups through management actions. This could occur through harassment (e.g., pyrotechnics, dogs), relocation, and lethal control methods. However, it is not uncommon for goose family units to experience change. Bellrose (1980) cites several sources which list annual mortality rates of juvenile Canada geese ranging from 7 to 19% during the hatching to fledging stage. Biologists believe that juvenile geese have a good likelihood of survival without adult geese once the juvenile reaches fledging stage, which occurs by July for most juvenile geese. Therefore, molting juvenile geese that escape capture or relocated would most likely survive to adulthood (Mississippi Flyway Council Technical Section 1996). Separated adults form new pair bonds and readily breed with new mates (Moser et al. 1991).

4.1.4.2 Alternative 2: Technical Assistance Only by WS

Under this alternative, WS would not conduct any lethal or nonlethal management actions, and would provide self-help advice only. Thus, methods viewed as inhumane by some persons would not be used by WS. However, without WS direct management assistance, it is expected that many people experiencing goose damage would implement their own damage management program. Overall, impacts on humaneness and animal welfare concerns associated with Canada goose damage management under this alternative would likely be similar to the proposed action alternative.

4.1.4.3 Alternative 3: Nonlethal Only By WS

Under this alternative, lethal methods viewed as inhumane by some persons would not be used by WS. However, it is expected that many requesters of goose damage management assistance would likely implement lethal methods that would not be available from WS.

Overall, Canada goose damage management under this alternative would likely be similar to the proposed action alternative.

4.1.4.4 Alternative 4: No Federal WS Canada Goose Damage Management

Under this alternative, methods viewed as inhumane by some persons would not be used by WS. However, these methods could be used by non-WS entities and, similar to the proposed action alternative, would be viewed by some persons as inhumane. Overall, Canada goose damage management under this alternative would likely be similar to the proposed action alternative.

4.1.5 Effects on Nontarget Wildlife Species Populations, Including T&E Species

4.1.5.1 Alternative 1: Integrated Wildlife Damage Management Program (Proposed Action/No Action)

WS, other wildlife professionals, and the public are concerned with the impact of damage management methods and activities on nontarget species, especially T&E species. WS's standard operating procedures include measures intended to mitigate or reduce the effects on nontarget species populations and are presented in Chapter 3. WS does not anticipate the unintentional lethal take of any nontarget wildlife species. While every precaution is taken to safeguard against taking nontarget species, at times changes in local animal movement patterns and other unanticipated events could result in the incidental take of unintended species. These occurrences are rare and should not affect the overall populations of any species under the proposed program.

WS abides by laws and regulations of the MBTA regarding migratory birds (50 CFR§21). Nontarget migratory bird species and other wildlife species are usually not affected by WS's management methods, except for the occasional scaring from harassment devices. In these cases, migratory birds and other affected wildlife may temporarily leave the immediate vicinity of scaring, but would most likely return after conclusion of the action.

Nonlethal chemical products that might be used or recommended by WS would include repellents such as methyl or di-methyl anthranilate (artificial grape flavoring used in foods and soft drinks sold for human consumption), which has been used as an area repellent, anthraquinone, and the tranquilizer drug alpha-chloralose. Such chemicals have undergone rigorous testing and research to prove safety, effectiveness, and low environmental risks before they would be registered by EPA or FDA. Any operational use of chemical repellents would be in accordance with labeling requirements under FIFRA and State pesticide laws and regulations which are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on wildlife populations.

Based on a thorough Risk Assessment, APHIS concluded that, when chemical methods are used by WS in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997).

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. WS has obtained the list of Federally listed T&E species for the state of North Carolina (see Appendix C). WS has consulted with the USFWS under Section 7 of the ESA concerning potential impacts of Canada goose damage management methods on T&E species and has obtained a Biological Opinion (USDI 1992). For the full context of the Biological Opinion, see Appendix F of the ADC Final EIS (USDA 1997, Appendix F).

WS Canada goose damage management activities in North Carolina would not adversely affect the shortnose sturgeon, American alligator, red wolf, loggerhead sea turtle, piping plaver (Atlantic), green sea turtle, Virginia big-eared bat , leatherback sea turtle, hawksbill sea turtle, spotfin chub, Carolina northern flying squirrel, bald eagle, kemp's ridley sea turtle, wood stork, gray bat, Indiana bat, eastern cougar, roseate tern, tar river spinymussel, small whorled pogonia, southern spicebush, rough-leaved loosestrife, canby's dropwort, bunched arrowhead, mountain sweet pitcher-plant, green pitcher-plant, and the blue ridge goldenrod. This determination is based on the conclusions made by the FWS during their 1992 programmatic consultation of WS activities and subsequent Biological Opinion (USDA 1997, Appendix F). The USFWS determined that the management activities being utilized for WS Canada goose damage management activities are not likely to adversely affect these listed species. WS has determined that the use of Canada goose damage management methods will have no effect on those T&E species not included in the 1992 Biological Opinion or their critical habitats. Furthermore WS has determined that the use Alpha-chloralose and lasers will have no effect on any listed T&E species. The USFWS concurs that WS Canada goose damage management activities will not likely adversely affect any federally listed T&E or proposed species in North Carolina (P. Cole, USFWS, May 14, 2003).

WS has obtained and reviewed the list of North Carolina State listed T&E species, species of concern, and species of special interest and has determined that the proposed WS goose damage management program will not adversely affect any of the species listed in North Carolina

4.1.5.2 Alternative 2: Technical Assistance Only by WS

There would be no impact on nontarget or T&E species by WS activities from this alternative. Only technical assistance or self-help information would be provided upon request. Although technical support might lead to more selective use of control methods by private individuals than that which might occur under Alternative 4, private efforts to reduce or prevent depredations could still result in less experienced persons implementing control methods leading to greater take of nontarget wildlife than under the proposed

action. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of Canada geese, which could lead to unknown effects on local nontarget species populations, including some T&E species. Hazards to raptors, including bald eagles and falcons, could therefore be greater under this alternative if chemicals that are less selective or that cause secondary poisoning are used by frustrated private individuals.

4.1.5.3 Alternative 3: Nonlethal Only By WS

Under this alternative, WS take of nontarget animals would hypothetically be less than that of the proposed action because no lethal control actions would be taken by WS. However, nontarget take would not differ substantially from the proposed program because WS does not anticipate the unintentional lethal take of any nontarget wildlife species under the proposed action. On the other hand, people whose Canada goose damage problems were not effectively resolved by nonlethal control methods would likely resort to other means of lethal control such as use of shooting by private persons or even illegal use of chemical toxicants. This could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than the proposed action. For example, shooting by persons not proficient at bird identification could lead to killing of nontarget birds. It is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of geese which could lead to unknown effects on local nontarget species populations, including T&E species. Hazards to raptors, including bald eagles and falcons, could therefore be greater under this alternative if chemicals that are less selective or that cause secondary poisoning are used by frustrated private individuals. Potential impacts of WS use of non-lethal chemicals would be similar to the proposed action.

4.1.5.4 Alternative 4: No Federal WS Canada Goose Damage Management.

There would be no impact on nontarget or T&E species by WS activities from this alternative. However, private efforts to reduce or prevent depredations could increase, which could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than under the proposed action. It is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of Canada geese which could impact local nontarget species populations, including some T&E species. Hazards to raptors, including bald eagles and peregrines, could therefore be greater under this alternative if chemicals that are less selective or that cause secondary poisoning are used by frustrated private individuals.

4.2 CUMULATIVE IMPACTS

Cumulative impacts are impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts of public actions to reduce Canada goose damage in the absence of WS assistance

(Alternative 4) can only be speculated. Similarly, cumulative impacts of public actions to reduce Canada goose damage in the absence of WS direct damage management assistance (Alternative 2) can only be speculated. However, it is reasonable to expect that as governmental assistance in resolving wildlife conflicts decreases, independent actions increase. The environmental desirability of these actions would be dependent upon the individuals who implement them. Many such actions would be poorly monitored, and public accountability would likely be low. For these reasons, cumulative impacts to the environment may be expected to increase as WS assistance decreases.

No significant cumulative environmental impacts are expected from any of the 4 alternatives. Under the Proposed Action, including the lethal removal of Canada geese by WS, would not have a significant impact on overall resident or migratory Canada goose populations in North Carolina or the Atlantic Flyway, but some local reductions may occur. Although some persons will likely be opposed to WS participation in Canada goose damage management activities, the analysis in this EA indicates that the proposed WS Integrated Canada goose damage management program will not result in significant cumulative adverse impacts on the quality of the human environment. Table 4-1 summarizes the expected impacts of the alternatives on each of the issues.

Table 4-1. Summary of the expected impacts of each of the alternatives on each of the issues related to Canada goose damage management by WS in North Carolina.

Issues	*Alternative 1 Integrated Wildlife Damage Management Program (Proposed Action)*	*Alternative 2 Technical Assistance Only by WS (No Action)*	*Alternative 3 Nonlethal Only by WS*	*Alternative 4 No Federal WS Canada Goose Damage Management Program*
Effects on Target Canada Goose Populations	Low effect - reductions in local Canada goose numbers; would not adversely affect state and flyway populations.	Low effect – No effect by WS; reductions in local Canada goose numbers by non-WS personnel likely; would not adversely affect state and flyway populations.	Low effect – No effect by WS; reductions in local Canada goose numbers by non-WS personnel likely; would not adversely affect state and flyway populations.	Low effect – No effect by WS; reductions in local Canada goose numbers by non-WS personnel likely; would not adversely affect state and flyway populations.
Effectiveness of Canada Goose Damage Management	The proposed action has the greatest potential of successfully reducing Canada goose conflicts and damage	Impacts could be similar or less than the proposed action dependent upon action taken by non-WS personnel.	Impacts could be similar or less than the proposed action dependent upon action taken by non-WS personnel.	Impacts could be similar or less than the proposed action dependent upon action taken by non-WS personnel.

Issues	*Alternative 1 Integrated Wildlife Damage Management Program (Proposed Action)*	*Alternative 2 Technical Assistance Only by WS (No Action)*	*Alternative 3 Nonlethal Only by WS*	*Alternative 4 No Federal WS Canada Goose Damage Management Program*
Effects on Human Affectionate-Bonds With Individual Birds and On Aesthetics	Low to moderate effect at local levels; Some local populations may be reduced; WS Canada goose damage management activities do not adversely affect overall regional or state Canada goose populations.	Low to moderate effect. No effect by WS; local Canada goose numbers in damage situations would remain high or possibly increase unless non-WS personnel successfully implement lethal methods; no adverse affect on overall regional and state Canada goose populations.	Low to moderate effect. Local Canada goose numbers in damage situations would remain high or possibly increase when non-lethal methods are ineffective unless non-WS personnel successfully implement lethal methods; no adverse affect on overall regional and state Canada goose populations.	Low to moderate effect. No effect by WS; local Canada goose numbers in damage situations would remain high or possibly increase unless non-WS personnel successfully implement lethal methods; no adverse affect on overall regional and state Canada goose populations.

Effects On Aesthetic Values of Property Damaged by Canada Geese	Low effect - Canada goose damage problems most likely to be resolved without creating or moving problems elsewhere.	Moderate to High effect – No effect by WS; Canada geese may move to other sites which can create aesthetic damage problems at new sites.	Moderate to High effect - Canada geese may move to other sites which can create aesthetic damage problems at new sites. Less likely than Alt. 2 and 4.	High – No effect by WS; nuisance Canada goose problems less likely to be resolved without WS involvement. Canada geese may move to other sites which can create aesthetic damage problems at new sites
Humaneness and Animal Welfare Concerns of Methods Used by WS	Low to moderate effect - methods viewed by some people as inhumane would be used by WS	No effect by WS. Impacts by non-WS personnel would be variable.	Lower effect than Alt. 1 since only non-lethal methods would be used by WS	No effect by WS. Impacts by non-WS personnel would be variable.
Effects on Nontarget Wildlife Species Populations, Including T&E Species	Low effect - methods used by WS would be highly selective with very little risk to nontarget species.	No effect by WS. Impacts by non-WS personnel would be variable.	Low effect - methods used by WS would be highly selective with very little risk to nontarget species.	No effect by WS. Impacts by non-WS personnel would be variable.

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APPENDIX A

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APPENDIX B

Canada Goose Damage Management Methods Available for Use or Recommended by the North Carolina Wildlife Services Program

The most effective approach to resolving wildlife damage problems is to integrate the use of several methods, either simultaneously or sequentially. Integrated Wildlife Damage Management (IWDM) would integrate and apply practical methods of prevention and reduce damage by wildlife while minimizing harmful effects of damage reduction measures on humans, other species, and the environment. IWDM may incorporate resource management, physical exclusion and deterrents, and population management, or any combination of these, depending on the characteristics of specific damage problems.

In selecting damage management techniques for specific damage situations, consideration is given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of wildlife damage. Consideration is also given to the status of target and potential nontarget species, local environmental conditions and impacts, social and legal aspects, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. These factors are evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods are potentially available to the WS program in North Carolina relative to the management or reduction of damage from Canada geese. WS develops and recommends or implements IWDM strategies based on resource management, physical exclusion and wildlife management approaches. Within each approach there may be available a number of specific methods or tactics.

Various federal, state, and local statutes and regulations and WS directives govern WS use of damage management tools and substances. The following methods and materials may be recommended or used in technical assistance and direct damage management efforts of the WS program in North Carolina. The effectiveness of the program can be defined in terms of reduced economic losses, decreased health hazards, minimized property damage and improved quality of life.

RESOURCE MANAGEMENT

Resource management includes a variety of practices that may be used by resource owners to reduce the potential for wildlife damage. Implementation of these practices is appropriate when the potential for damage can be reduced without significantly increasing a resource owner's costs or diminishing his/her ability to manage resources pursuant to goals. Resource management recommendations are made through WS technical assistance efforts.

Habitat Alteration: Habitat alteration can be the planting of vegetation unpalatable to wildlife or altering the physical habitat (Conover and Kania 1991, Conover 1992). Conover (1991[a], 1991[b]) found that even hungry Canada geese refused to eat some ground covers such as common periwinkle (*Vinca minor*), English ivy (*Hedera helix*) and Japanese pachysandra (*Pachysandra terminalis*). Planting less preferred plants or grasses to discourage geese from a specific area may be effective if good alternative feeding sites are nearby (Conover 1985). However, the manipulation of turf grass varieties in urban/suburban and heavy use situations in North Carolina (such as parks, athletic fields and golf courses) is often not feasible. Varieties of turf grass that grow

well in North Carolina and can withstand regular mowing and regular/heavy human use include: Kentucky blue grass, red fescue, perennial bent grass, perennial rye grass and white clover. All of these grasses are appealing to Canada geese. The turf grass varieties that are not appealing to Canada geese such as, tall fescue, orchard grass and timothy, do not withstand regular mowing and/or regular/heavy human use.

Fences, hedges, shrubs, boulders, etc. can be placed at shorelines to impede goose movements. Restricting a goose's ability to move between water and land will deter geese from an area, especially during molts (Gosser et al. 1997). However, people are often reluctant to make appropriate landscape modifications to discourage goose activity (Breault and McKelvey 1991, Conover and Kania 1991). Unfortunately, both humans and geese appear to find lawn areas near water attractive (Addison and Amernic 1983, Cooper[a] In Press), and conflicts between humans and geese will likely continue wherever this interface occurs. Cooper (1998) reported that 93% of current shoreline turf, in the Twin Cities metropolitan area, would be needed to be modified to limit the goose population to established goals, and this approach may be unacceptable to the human residents. To limit the resident goose population size in the Twin Cities region of Minnesota, Cooper (1998) estimated costs of modifying habitat at $33.9 million for tall grass prairie and $1.8 billion for ground juniper (*Juniperus spp.*). Therefore, he concluded that shoreline habitat modification as a population management tool would be prohibitively expensive.

Removal of water bodies would likely reduce the attractiveness of an area to waterfowl. Urban/suburban Canada geese tend to feed near bodies of water with a distant view over short grass (Conover and Kania 1991). Draining/removal of water bodies is often considered unreasonable and aesthetically unacceptable. The draining of wetlands is strictly regulated by federal and state wetland laws and regulations, including the Clean Water Act. A U. S. Corp of Engineers permit may be necessary before actions are taken to drain bodies of water or wetlands.

Lure Crops: Lure crops are food resources planted to attract wildlife away from more valuable resources (e.g., crops). This method is largely ineffective for urban resident Canada geese since food (turf) resources are readily available. Lure crops generally reduce damage for only a short time (Fairaizl and Pfeifer 1988). For lure crops to be effective, the ability to keep birds from surrounding fields would be necessary, and the number of alternative feeding sites must be minimal (Fairaizl and Pfeifer 1988). The resource owner is limited in implementing this method contingent upon ownership of, or otherwise ability to manage the the lure crop property. Furthermore, the creation of additional waterfowl habitat could increase future conflicts.

Lure crops may be planted on some land held in private ownership, such as conservation clubs, throughout the state. These plantings may provide some additional food or act as an attractant for geese. However, it is highly unlikely they contribute to conflicts with geese or act as substantial goose attractants.

Modify Human Behavior: Artificial feeding of Canada geese by people attracts and sustains more birds in an area than could be supported by natural food supplies. This unnatural food source exacerbates damage by resident geese. The elimination of feeding of Canada geese is a primary recommendation made by WS, and many local municipalities and homeowners associations have adopted policies and ordinances prohibiting it. Some parks have posted signs, and there have been efforts made to educate the public on the negative aspects of feeding Canada geese. However, sometimes people do not comply, and the policies are poorly enforced in some areas.

Alternatively, some entities do not prohibit the feeding of geese because the goose population in the location has not exceeded the WAC. It is unlikely that the feeding of geese in these locations would appreciably contribute to conflicts with geese in other communities or locations.

Alter Aircraft Flight Patterns: In cases where the presence of Canada geese at airports results in threats to human safety, and when such problems cannot be resolved by other means, the alteration of aircraft flight patterns or schedules may be recommended. However, altering operations at airports to decrease the potential for hazards is not feasible unless an emergency situation exists. The expense of interrupted flights and the limitations of existing facilities make this practice prohibitive.

Removal of Domestic Waterfowl: Flocks of urban waterfowl are known to act as "decoys" and attract migrating waterfowl (Crisley et al. 1968, Woronecki 1992, AAWV undated). Rabenold (1987) and Avery (1994) reported that birds learn to locate food resources by watching the behavior of other birds. The removal of domestic waterfowl from ponds removes birds that act as "decoys" in attracting Canada geese. Property or resource owners may be reluctant to remove some or all decoy birds because of the enjoyment of their presence.

PHYSICAL EXCLUSION AND DETERRENTS

Physical exclusion and deterrents restrict the access of wildlife to resources and/or alter behavior of target animals to reduce damage. These methods provide a means of appropriate and effective prevention of resident Canada goose damage in many situations.

Electric Fence: The application of electrified fencing is generally limited to rural settings, due to the possibility/likelihood of electricity interacting with people and pets. Limits of this application arise where there are multiple landowners along the wetland, pond, or lake, and the size of the field and its proximity to bodies of water used by resident geese. Perceptions from Minnesota on the effectiveness of electric fences were high (Cooper and Keefe 1997). While electric fencing may be effective in repelling geese in some urban settings, its use is often prohibited in many municipalities for human safety reasons. Problems that typically reduce the effectiveness of electric fences include; vegetation on fence, flight capable geese, fencing knocked down by other animals (e.g., white-tailed deer and dogs), and poor power.

Barrier Fence: The construction or placement of physical barriers has limited application for geese. The application of this method is limited to areas that can be completely enclosed and do not allow geese to land inside enclosures. Barriers can be temporary or permanent structures. Lawn furniture/ornaments, vehicles, boats, snow fencing, plastic hazard fencing, metal wire fencing, and multiple strand fencing have all been used in to limit the movement of resident geese. Unfortunately, there have been situations where barrier fencing designed to inhibit goose nesting has entrapped goslings and resulted in starvation (Cooper 1998).

Perceptions from Minnesota indicate that permanent barriers were highly effective, while temporary barriers were moderately effective (Cooper and Keefe 1997). Similar to most abatement techniques, this method has been most effective when dealing with small numbers of breeding geese and their flightless goslings along wetlands and/or waterways. The preference for geese to walk or swim, rather than fly, during this time period contributes to the success of barrier fences. Geese that are capable of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing. However, site specific habitat alterations have merit, provided that landscape designs are based on biological diversity and human safety objectives

(Cooper[b] In Press). To limit the resident goose population size in the Twin Cities region of Minnesota with wire fences, Cooper (1998) estimated it would cost $12.3 million for 25 years.

Surface Coverings: Canada geese may be excluded from ponds using overhead wire grids (Fairaizl 1992, Lowney 1993). Overhead wire grids have been demonstrated to be most applicable on ponds ≤ two acres, but wire grids may be considered aesthetically unappealing to some people. Wire grids render a pond unusable for boating, swimming, fishing, and other recreational activities. Installation costs are about $1,000 per surface acre for materials. The expense of maintaining wire grids may be burdensome for some people. Balls approximately five inches in diameter can be used to cover the surface of a pond. A "ball blanket" renders a pond unusable for boating, swimming, fishing, and other recreational activities. This method is very expensive, costing about $131,000 per surface acre of water.

Visual Deterrents: Reflective tape has been used successfully to repel some birds from crops when spaced at three to five meter intervals (Bruggers et al. 1986, Dolbeer et al. 1986). Mylar flagging has been reported effective at reducing migrant Canada goose damage to crops (Heinrich and Craven 1990). Mason et al. (1993) and Mason and Clark (1994) have shown white and black plastic flags to be effective at repelling snow geese from pastures when alternative grazing areas were available. Flagging is impractical in many locations and has met with some local resistance due to the negative aesthetic appearance presented on the properties where it is used. Other studies have shown reflective tape ineffective (Tobin et al. 1988, Bruggers et al. 1986, Dolbeer et al. 1986, Conover and Dolbeer 1989). While sometimes effective for short periods of time, reflective tape has proven mostly ineffective in deterring resident geese.

Mute Swans: Mute swans are ineffective at preventing Canada geese from using or nesting on ponds (Conover and Kania 1994). Additionally, swans can be aggressive towards humans (Conover and Kania 1994, Chasko 1986) and may have undesirable effects on native aquatic vegetation (Allin et al. 1987, Chasko 1986). Executive Order 11987 May 24, 1977, states that federal agencies shall encourage states, local governments, and private citizens to prevent the introduction of exotic species into the environment. Until recently, mute swans were classified as an exotic species by the Federal government. A recent court case as the U.S. Court of Appeals for the District of Columbia ruled that mute swans are covered by protective/management authorities contained in the Migratory Bird Treaty Act. The use of mute swans as a Canada goose damage management technique is ineffective, and not recommended.

Dogs: Dogs can be effective at harassing geese and keeping them off turf and beaches (Conover and Chasko 1985, Castelli and Sleggs 2000). Around water, this technique appears most effective when the body of water to be patrolled is less than two acres in size (Swift 1998). Although dogs can be effective in keeping geese off individual properties, they do not contribute to a solution for the larger problem of overabundant goose populations (Castelli and Sleggs 2000). Swift (1998) reported that when harassment with dogs ceases, the number of geese return to pre-treatment numbers. WS recommends and encourages the use of dogs where appropriate.

Repellents: Methyl anthranilate (MA) is a registered repellent for Canada geese is marketed under the trade names ReJeX-iT and Bird Shield. Results with MA appear to be mixed. Cummings et al. (1995) reported that MA repelled Canada geese from grazing turf for four days. However, Belant et al. (1996) found it ineffective as a grazing repellent when applied at 22.6 and 67.8 kg/ha which is the label rate and triple the label rate, respectively. MA is water soluble therefore, moderate to heavy rain or daily watering and/or mowing render MA ineffective. To use chemical repellents for goose damage management in North Carolina,

State regulations governing use of restricted chemicals must be followed. Testing in numerous locations throughout Wisconsin during the 1990's indicated that in many situations MA is cost prohibitive, is only marginally effective in repelling geese, and commonly just causes geese to move to nearby untreated areas. (P. Vagnini, West Bend Parks, Recr. and For. Dept., April, 2000, D. Keuler, Rock River Hills Golf Course, April, 2000, and G. Youngs, Milwaukee County Dept. Parks, Recr. and Culture, March, 2000, pers. comm.).

Research continues on other avian feeding repellents. A 50% anthraquinone product (FlightControl®), shows promise for Canada geese (Dolbeer et al. 1998). Like MA, anthraquinone has low toxicity to birds and mammals. Activated charcoal has also been evaluated for use in deterring goose damage, but it requires frequent re-application to effectively reduce goose damage (Mason and Clark 1995). Further, laboratory and field trials are needed to refine minimum repellent levels and to enhance retention of treated vegetation (Sinnott 1998).

Hazing: In some locations and circumstances, hazing Canada geese is a useful component of a Canada goose damage management program. Hazing reduces losses and conflicts in those instances when the affected geese move to more acceptable areas. Achieving that end has become more difficult as the local goose population increases. Birds hazed from one area where they are causing damage, frequently move to another area where they cause damage (Brough 1969, Conover 1984, Summers 1985, Swift 1998). Smith et al. (1999) noted that others have reported similar results, stating: "..biologists are finding that some techniques (e.g., habitat modifications or scare devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and geese become more accustomed to human activity". Generally speaking, birds tend to habituate to hazing techniques (Zucchi and Bergman 1975, Blokpoel 1976, Summers 1985, Aubin 1990).

Scarecrows: The use of scarecrows has had mixed results. Effigies depicting alligators, humans, floating swans and dead geese have been employed, with limited success for short time periods in small areas. An integrated approach (swan and predator effigies, distress calls and nonlethal chemical repellents) was found to be ineffective at scaring or repelling nuisance Canada geese (Conover and Chasko 1985). While Heinrich and Craven (1990) reported that using scarecrows reduced migrant Canada goose use of agricultural fields in rural areas, their effectiveness in scaring geese from suburban/urban areas is severely limited because geese are not afraid of humans as a result of nearly constant contact with people. In general, scarecrows are most effective when they are moved frequently, alternated with other methods, and are well maintained. However, scarecrows tend to lose effectiveness over time and become less effective as goose populations increase (Smith et al. 1999).

Distress Calls: Aguilera et al. (1991) found distress calls ineffective in causing migratory and resident geese to abandon a pond. Although, Mott and Timbrook (1988) reported distress calls as effective at repelling resident Canada geese 100 meters from the distress unit, the geese would return shortly after the calls stopped. The repellency effect was enhanced when pyrotechnics were used with the distress calls. In some situations, the level of volume required for this method to be effective in urban/suburban areas would be prohibited by local noise ordinances. A similar device, which electronically generates sound, has proven ineffective at repelling migrant Canada geese (Heinrich and Craven 1990).

Lasers: The use of lasers as nonlethal avian damage control tools, have recently been evaluated for a number of species (Blackwell et al. 2002); research on this potential tool has been conducted in a replicated format only for double-crested cormorants (Glahn et al. 2000). In experimental situations, Canada geese have exhibited avoidance reactions to lasers under low light conditions (Blackwell et al. 2002), and a field test of

lasers at a Pennsylvania site demonstrated effectiveness of lasers in dispersing large flocks of geese off of a lake, with nearly no habituation to the technique (Cepek et al. 2001). The integrated use of lasers as part of Canada goose damage management programs by WS in North Carolina may increase program effectiveness, and would be incorporated as appropriate. Wide scale public use of lasers is not typically recommended at this time, pending additional research (on effectiveness and impacts) on its use as a Canada goose damage management tool. In some situations (neighborhoods, schools, hospitals), use of lasers may enhance integrated control programs since they are silent and do not fire a projectile.

Pyrotechnics: Pyrotechnics (screamer shells, bird bombs, and 12-gauge cracker shells) have been used to repel many species of birds (Booth 1994). Aguilera et al. (1991) found 15mm screamer shells effective at reducing resident and migrant Canada geese use of areas of Colorado. However, Mott and Timbrook (1988) and Aguilera et al. (1991) doubted the efficacy of harassment and believed that moving the geese simply redistributed the problem to other locations. Fairaizl (1992) and Conomy et al. (1998) found the effectiveness of pyrotechnics highly variable among different flocks of waterfowl. Some flocks in urban areas required continuous harassment throughout the day with frequent discharges of pyrotechnics. The geese usually returned within hours. A minority of resident Canada goose flocks in Virginia showed no response to pyrotechnics (Fairaizl 1992). Some flocks of Canada geese in Virginia have shown quick response to pyrotechnics during winter months suggesting migrant geese made up some or all of the flock (Fairaizl 1992). Shultz et al. (1988) reported fidelity of resident Canada geese to feeding and loafing areas is strong, even when heavy hunting pressure is ongoing. Mott and Timbrook (1988) concluded that the efficacy of harassment with pyrotechnics is partially dependent on availability of alternative loafing and feeding areas. Although one of the more effective methods of frightening geese away, more often than not they simply move geese to other areas. There are also safety and legal implications regarding their use. Discharge of pyrotechnics is inappropriate and prohibited in some urban/suburban areas. Pyrotechnic projectiles can start fires, ricochet off buildings, pose traffic hazards, trigger dogs to bark incessantly, annoy and possibly injure people.

In North Carolina, pyrotechnic launchers may be considered as firearms by some law enforcement departments. In those cases, possession and use of pyrotechnic equipment would require acquisition of appropriate permits and licenses as directed by the local Police Department. Additionally, use of pyrotechnics in certain municipalities would be constrained by local firearm discharge and noise ordinances.

Propane Cannons: Although a propane cannon can be an effective dispersal tool for migrant geese in agricultural settings, resident geese in urban areas are more tolerant of noise and habituate to propane cannons relatively quickly. Propane cannons are generally inappropriate for urban/suburban areas due to the repeated loud explosions, which many people would consider a serious and unacceptable nuisance and potential health threat (hearing damage).

POPULATION MANAGEMENT

Potential methods of managing the local Canada goose population include relocation, contraception, egg destruction, capture with AC, toxicants, hunting and depredation permits, capture and euthanize.

Capture and Relocation: Smith (1996) reported that groups of juvenile geese relocated from urban to rural settings can effectively eliminate these geese from urban areas, retain geese at the release site, include them in the sport harvest, and expose them to higher natural mortality. Smith (1996) also reported that multiple

survival models indicated that survival estimates of relocated juveniles were half of those of urban captured and released birds. If this method in used to reduce damage in North Carolina, geese would be relocated away from problem areas to new/separate properties with appropriate landowner/manger permission.

Ultimately, the relocation of resident Canada geese from metropolitan communities can assist in the reduction of overabundant populations (Cooper and Keefe 1997), and has been accepted by the general public as a method of reducing goose populations to socially acceptable levels (Fairaizl 1992). In addition, the removal of geese posing or likely to pose a hazard to air safety at airports has been demonstrated to reduce the population of local geese and decrease the number of goose flights through the airport operations airspace; and resulted in increased air safety at the Minneapolis/St. Paul International Airport (Cooper 1991).

Contraception: Contraceptives have not proven to be an effective method for reducing damage, and there are no contraceptive drugs registered with the FDA for Canada geese. Although, Canada geese have been successfully vasectomized to reduce to prevent gosling production, this method is only effective if the female does not form a bond with a different male. In addition, vasectomies can only prevent the production of the mated pair. The ability to identify breeding pairs for isolation and to capture a male goose for vasectomization becomes increasingly difficult as the number of geese increase (Converse and Kennelly 1994). Canada geese have a long life span once they survive their first year (Cramp and Simmons 1977, Allan et al. 1995); leg-band recovery data indicate that some geese live longer than 20 years. The sterilization of resident Canada geese would not reduce the damage caused by the overabundance of the goose population since the population of Canada geese would remain relatively stable. Keefe (1996) estimated sterilization to cost over $100 per goose.

Egg Destruction/Reproduction Control: Egg addling, oiling, freezing, egg replacement, or puncturing can be effective in reducing recruitment into the local population (Christens et al. 1995, Cummings et al. 1997). While egg removal/destruction can reduce production of goslings, merely destroying an egg does not reduce a population as quickly as removing immature or breeding adults (Cooper and Keefe 1997). As with other species of long-lived geese, which require high adult mortality to reduce populations (Rockwell et. al 1997), it is likely that adult resident Canada geese must be removed to reduce the population to a level deemed acceptable to communities. Approximately five eggs must be removed to have the effect of stopping one adult from joining the breeding population (Rockwell et al. 1997, Schmutz et al. 1997). Keefe (1996) estimated egg destruction to cost $40 for the equivalent of removing one adult goose from the population. To equal the effect of removing an adult bird from a population, all eggs produced by that goose during its entire lifetime must be removed (Smith et al. 1999). Furthermore, egg removal efforts must be nearly complete in order to prevent recruitment from a small number of surviving nests that would offset control efforts (Smith et al. 1999). Cooper and Keefe (1997), Rockwell et al. (1997), and Schmutz et al. (1997) reported that goose egg destruction is only fractionally effective in attaining population reduction objectives, and that nest/egg destruction is not an efficient or cost-effective damage management or population reduction approach.

The Mississippi Flyway Giant Canada Goose Management Plan (Mississippi Flyway Council Technical Section. 1996), states that to effectively reduce resident goose populations, an increase in adult and immature mortality rates, combined with reproductive control, is necessary. Reproductive control alone can not reduce the population in an acceptable time; treatment of 95% of all eggs each year would result in only a 25% reduction over 10 years (Allan et al. 1995). In contrast, reducing annual survival of resident geese by just 10% would reduce a predicted growth rate of +15%/year to a stable population, assuming moderate recruitment (Atlantic Flyway Council 1999). Nest destruction is estimated to cost significantly more than

other forms of population management (Cooper and Keefe 1997). Egg destruction, while a valuable tool, has fallen short as a single method for reducing local goose populations. Many nests cannot be found by resource managers in typical urban-suburban settings due to the difficulties in gaining access to search the hundreds of private properties where nests may occur. In addition, geese which have eggs oiled in successive years may learn to nest away from the water making it more difficult to find nests.

VerCauteren et al. (2000) examined the use of Nicarbazin (NCZ) to reduce Canada goose egg production and viability, and found that NCZ did experimentally reduce egg viability, but that there were difficulties in delivery methods and acceptance of treated feed. Additional research and field trials to document the extent to which NCZ is effective and practical as an operational population management tool are needed before this material is available to wildlife managers in field applications.

Capture With Alpha-chloralose: Alpha-chloralose may be used only by WS personnel to capture geese. Pursuant to FDA restrictions, geese captured with AC for subsequent euthanasia must be killed and buried or incinerated, or be held alive for at least 30 days, at which time the birds may be killed and processed for human consumption.

Toxicants: All pesticides are regulated by the EPA. There are currently no toxicants registered with the EPA for use on Canada geese and therefore none would be used by WS.

Hunting: WS sometimes recommends that resource owners consider legal hunting as an option for reducing goose damage. Legal hunting also reinforces harassment programs (Kadlec 1968). Nationwide, hunting is the major cause of goose mortality, but geese may seldom be available to hunters in an urban-suburban environment (Conover and Chasko 1985, Smith et al. 1999). Although legal hunting is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some populations of resident Canada geese. Zielske et al. (1993) believed legal hunting would not reduce Canada goose populations where there is limited interest in legally hunting resident Canada geese.

Hunting has had a major impact on the distribution of geese in the Minneapolis/St. Paul Metro Area of Minnesota (Cooper and Keefe 1997). They reported goose densities during the summer in hunted areas of the Metro Area (which comprised only 23% of the area) were significantly lower (three times lower) than densities in unhunted areas. Similarly, Conover and Kania (1991) reported that geese were more likely to cause damage in areas that goose hunting was prohibited. Even in urban/suburban areas (e.g., golf courses and green spaces) there may be locations where controlled hunting would be effective in reducing goose damage. In North Carolina, geese are legally harvested during 2 seasons: regular season and special September season. These seasons are described, and annual harvests are described in Section 1.3.2.3.

Shooting. Shooting is the practice of selectively removing target birds by shooting with a shotgun, rifle, or pellet gun. Shooting a few individuals from a larger flock can reinforce birds' fear of harassment techniques. Shooting is used to reduce goose problems when lethal methods are determined to be appropriate. The birds are killed as quickly and humanely as possible. Shooting geese can be highly effective in removing birds from specific areas and in supplementing harassment programs.

Currently, based upon recommendations provided by WS, depredation permits are issued by the USFWS to requesters for the purpose of reducing conflicts caused by Canada geese and migratory birds for a $25.00 fee.

In North Carolina, shooting geese pursuant to a USFWS issued Depredation Permit is conducted primarily by farmers, airport personnel, municipal and county park personnel, and others.

Capture and Euthanize: The most efficient way to reduce the size of an urban-suburban flock of resident Canada geese is to increase mortality among adult geese. Except for hunting, capture and removal of Canada geese is the most cost effective lethal method to reduce damage (Cooper and Keefe 1997). For purposes of lethal control, geese may be captured with panel nets, rocket nets, drive traps, net guns, dip nets, and/or by hand. Geese that are captured and euthanized would be buried, incinerated, or processed for charitable donation.

Rocket netting involves the setting of bait in an area that would be completely contained within the dimensions of a manually propelled net. The launching of the rocket net occurs too quickly for the geese to escape. Rocket netting may take place anytime during the year. Using a net gun to capture geese can be conducted anytime during the year by firing a net from a shoulder mounted gun.

Panel nets as described by Costanzo et al. (1995) are lightweight, portable panels (approximate size 4' x 10') that are used to herd and surround flightless geese into a moveable catch pen. This method is equally efficient on hard (pavement) and soft (field) surfaces, and can be employed in such as way as to reduce stress on captured birds (place the catch pen in a shaded area) and control other impacts (place far from roadways). The molt process, when resident Canada geese are flightless, typically occurs from early June through mid-July. Resident Canada geese captured during this period may be processed for human consumption and donated to charitable organizations. Canada geese captured and processed for donation geese would only be processed by facilities licensed by the state governing authority. Typically, costs of processing and donation are paid by the requestor, and processing would usually occur at poultry processing facilities. Geese determined to be unsuitable for human consumption would be disposed of pursuant to permitted authorities.

APPENDIX C

Federal Listed Threatened and Endangered Species in North Carolina

Common Name	Scientific Name	Status
Vertebrates:		
Shortnose sturgeon	*Acipenser brevirostrum*	E
American Alligator	*Alligator mississippiensis*	T(S/A)
Red wolf	*Canis rufus*	E
Loggerhead sea turtle	*Caretta caretta*	T
Piping plover (Atlantic)	*Charadrius melodus*	T
Green sea turtle	*Chelonia mydas*	T
Bog turtle	*Clemmys muhlenbergii*	T(S/A)
Virginia big-eared bat	*Townsendii virginianus*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Hawksbill sea turtle	*Eretmochelys imbricate*	E
Spotfin chub	*Erimonax monachus*	T
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	E
Bald eagle	*Haliaeetus leucocephalus*	T (proposed for delisting)
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Waccamaw silverside	*Menidia extensa*	T
Wood stork	*Mycteria Americana*	E
Gray bat	*Myotis grisescens*	E
Indiana bat	*Myotis sodalis*	E
Cape Fear shiner	*Notropis mekistocholas*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Eastern cougar	*Puma concolor couguar*	E
Roseate tern	*Sterna dougallii*	E
Manatee	*Trichechus manatus*	E
Invertebrates:		
Dwarf wedgemussel	*Alasmidonta heterodon*	E
Appalachian elktoe	*Alasmidonta raveneliana*	E
Tar river spinymussel	*Elliptio steinstansana*	E
Oyster mussel	*Epioblasma capsaeformis*	E
Carolina heelsplitter	*Lasmigona decorate*	E
Spruce-fir moss spider	*Microhexura montivaga*	E
Saint Francis' satyr	*Neonympha mitchellii francisci*	E
Noonday globe (=snail)	*Patera clatki nantahala*	T
Littlewing pearlymussel	*Pegias fabula*	E
James spinymussel	*Pleurobema collina*	E
Cumberland bean	*Waltoncythere acuta*	E

Vascular Plants:

Sensitive jointvetch	*Aeschynomene virginica*	T
Seabeach amaranth	*Amaranthus pumilus*	T
Small-anthered bittercress	*Cardamine micranthera*	E
Golden sedge	*Carex lutea*	E
Smooth coneflower	*Echinacea laevigata*	E
Spreading avens	*Geum radiatum*	E
Schweinitz's sunflower	*Helianthus schweinitzii*	E
Swamp pink	*Helonias bullata*	T
Dwarf-flowered heartleaf	*Hexastylis naniflora*	T
Roan Mountain bluet	*Houstonia montana*	E
Mountain golden heather	*Hodsonia montana*	T
Small whorled pogonia	*Isotria medeoloides*	T
Heller's blazing star	*Liatris helleri*	T
Southern spicebush	*Lindera melissifolia*	E
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
Harperella	*Ptilimnium nodosum*	E
Michaux's sumac	*Rhus michauxii*	E
Bunched arrowhead	*Sagittaria fasciculata*	E
Mountain sweet pitcher-plant	*Sarracenia rubra ssp. Jonesii*	E
Green pitcher-plant	*Sarracenia oreophila*	E
American chaffseed	*Schwalbea americana*	E
White irisette	*Sisyrinchium dichotomum*	E
Blue Ridge goldenrod	*Solidago spithamaea*	T
Virginia spiraea	*Spiraea virginiana*	T
Cooley's meadowrue	*Thalictrum cooleyi*	E

Nonvascular Plants:

Rock gnome lichen	*Gymnoderma lineare*	E

E - Endangered, T – Threatened, S/A – Federally protected due to similarity of appearance